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FOREWORD

Conference on Information Technology for Practice 2020

Ladies and gentlemen, you are receiving the proceedings of the traditional international conference IT for Practice 2020 (IT4P), which was organized as the 23rd year. Due to the pandemic situation in the Czech Republic, the conference was organized on an unconventional date on December 3, 2020 via the Internet as an online conference. I would like to thank all the participants who presented their contributions in this environment.

The conference was organized by the auspices of EUNIS-CZ (Association of European University Information Systems of the Czech Republic), ČSSI (Czech Society for System Integration), CIT (Center for Information Technologies VŠB-Technical University of Ostrava) and IT Cluster z.s. The conference is appreciated within the European Union for its content focused on the practical use of information technology. The organizers are trying to register this conference in recognized databases.

According to the title of the conference, the participants come from academic staff, managers and employees of ICI, IS designers in companies and institutions, ICT providers and students. The topics of this year's conference are:

- Information Society and Education;
- Information Management and IT Innovation;
- Information Security;
- Digitalization in Pandemic condition

The purpose of the organizers is to create a platform for the exchange of knowledge and skills in the field of ICT innovation and the use of new knowledge in practice, as it is not easy to attract professionals willing to share their experiences.

Thanks also to all sponsors who contributed to the financial support of the conference

We wish you successful use of the professional contacts and information you obtained at the conference in solving specific problems in your companies and institutions.

On behalf of the organizers

Jan Ministr

C O N T E N T S

INFORMATION SOCIETY AND EDUCATION

The Top ICT-Trends to Accelerate Digital Transformation in VUCA-Environment

Piotr Adamczewski[1]

Abstract. The four terms Volatility, Uncertainty, Complexity and Ambiguity describe the nature of the VUCA environment in which we and our workforce have to act now and in the future. The topic on everyone's lips is change in businesses. We need change management. Digital transformation is accelerating change and innovation cycles are becoming shorter. This is causing volatility. Nobody can predict what anything is going to be like, or which start-up will destroy the which multinational next. Cause and effect can no longer be identified in the VUCA- Environment. We are making more misjudgements because we cannot resolve ambiguous signals. Solutions Digital technologies are transforming operations, products and services in organi-sations large and small. Solutions of the Information and Co-mmunication Technology (ICT) are the foundation of modern economic organizations in a time of digital transformation. This article is aimed at describing the role of modern ICT-Trends in intelligent organizations, which are described as SMAC, (Social, Mobility, Analytics, Cloud), Internet of Things, AI and are be-coming an essential ICT element supporting management processes in VUCA-Environment of business.

Keywords: Digital transformation, Intelligent organization, ICT-Trends, SMAC, VUCA.

JEL Classification: C88

1 Introduction

Digital transformation - the use of technology to radically improve performance or reach of enterprises - is a hot topic for organizations across the globe. The dynamics of market changes and the high level of turbulence in business environment make modern economic organizations face the challenge of continuous improvement in their operational methods and development. In practice, it implies the necessity to use modern ICT solutions in knowledge management, which enable to support business processes within the acquisition and reinforcement of business's competitive advantages. Within the evolution of the information society towards

[1] WSB University in Poznań PL, Institute of Management, Poland, Adamczewski@wsb.poznan.pl.

the knowledge society, it boils down to the treatment of modern organizations as intelligent organizations. A intelligent organization is one whose business philosophy is based on knowledge management (Grösser, 2012). This term became popular in the 1990s owing to the growing ICT development, the dynamically changing economic environment, and the increasing market competitiveness. An intelligent organization is one that learns and has the capacity to create, acquire, organise, and share knowledge and use it in order to raise the efficiency of its operation and increase competitiveness on the global market. The idea of such an organization is based on the systemic approach to organization, i.e. its treatment as a complex organism founded on existing structures and executed processes, focusing on the role of knowledge. In that approach, which is called 'the fifth discipline' by P. Senge, owing to knowledge and suitable tools all elements of an organization and its personnel can collaborate in order to achieve set objectives (Schwaninger, 2010). Thanks to that, the whole organization operates as an intelligent and successful organism in the competitive environment. This explains the mutual relationships between methods of fulfilling targets, their understanding, methods of solving problems as well as internal and external communication.

This article is aimed at presenting the latest condition of digitalization and development tendencies in supporting the intelligent organizations with SMAC solutions (Social, Mobility, Analytics, and Cloud), Internet of Things and AI in VUCA-Environment of business, which is a sine qua non condition of enterprises from this sector to operate in a modern way and to take part in the process of digital transformation. ICT implementation in every organization depends on numerous factors, mostly organizational, human, and technical, but also on the needs of the management, which can be more or less conscious. Unlike large organizations, where the implementation of advanced SMAC is perceived positively, it seems that an opposite approach can occur to this ICT-Trends.

2 Intelligent organizations in VUCA-Environment

The most important characteristics of a intelligent organization include, among other (Grösser, 2012; Schwaninger, 2010)**:**

- fast and flexible operation,
- the ability to monitor the environment,

- the capacity to diagnose early market signals and to react to changes in the environment, and
- the ability to implement new knowledge-based solutions and achieve economic benefits therefrom.

The growing volume of information used in a intelligent organization is accompanied by its increasing importance. Peter Drucker indicated already that traditional factors of production, such as growth, labour, and capital, are losing their importance in favour of a key resource, namely knowledge applied in the creative operation of an organization. It constitutes intangible resources that are related to human actions, whose use may be the basis for gaining a competitive advantage (Schwaninger, 2010). Knowledge has to be treated as information embedded in the context of an organization and a skill to use it effectively in the organizational activity. It means that knowledge resources are data about its customers, products, processes, environment, etc. in a formalised form (documents, databases) and in non-codified forms (knowledge of staff).

In the practical dimension, the effective collaboration of such elements means the necessity to use advanced ICT solutions. Technical, technological, and organizational innovations, which have appeared in recent years, are all utilised (Adamczewski, 2019b). They encompass almost all areas of a modern organization operation, starting from means of transport and equipment, through organization and material and raw material flow management, to the development of system structures that implement business processes, i.e. within logistics systems that are the essence of modern management based on ICT solutions.

The present effect of the ICT evolution in the form of the so-called third ICT platform, has been treated since 2013 as the foundation of the 4th industrial revolution, being the natural development stage of the 3rd revolution of 1969 (its symbol being electronics with its transistor and automated production). The main distinguishing element of new changes has become the redefinition of the present course of business processes that contributes to new operating models of economic organizations facing new challenges to maintain their position and expand on the market further. The industrial revolution of the 4th stage is breaking out due to (Adamczewski, 2019a, Betz, 2015; McConnell, 2017; Schwab, 2016):

- the introduction of the all-present digitalization,
- decision processes based on virtual simulations and data processing in real time, and
- machine-machine and machine-man communication.

The digital transformation means a change of the present approach to a customer and a comprehensive process where an organization moves to new methods of operation using the state-of-the-art SMAC digital technology, including social media, mobility, big-data – analytics, and cloud computing. However, it has to be kept in mind that the role of digital technologies in that process is to enable the necessary changes and open an organization to new opportunities. Therefore, they should be a tool rather than the aim of transformation. The centre of the process has to be the customer and his needs, as the main driver for manufacturers and service providers. The digital transformation is no longer the method of gaining a competitive advantage – it is becoming a factor that enables to stay on the market (Riche, 2018).

VUCA is an acronym – first used in 1987, drawing on the leadership theories of Warren Bennis and Burt Nanus to describe or to reflect on the Volatility, Uncertainty, Complexity and Ambiguity of general conditions and situations (Wikipedia, 2020). The U.S. Army War College introduced the concept of VUCA to describe the more volatile, uncertain, complex and ambiguous multilateral world perceived as resulting from the end of the Cold War. More frequent use and discussion of the term "VUCA" began from 2002 and derives from this acronym from military education. It has subsequently taken root in emerging ideas in strategic leadership that apply in a wide range of organizations, from for-profit corporations to education.

The deeper meaning of each element of VUCA serves to enhance the strategic significance of VUCA foresight and insight as well as the behaviour of groups and individuals in organizations. It discusses systemic failures and behavioural failures, which are characteristic of organisational failure:

- Volatility - the nature and dynamics of change, and the nature and speed of change forces and change catalysts;
- Uncertainty - the lack of predictability, the prospects for surprise, and the sense of awareness and understanding of issues and events;
- Complexity - the multiplex of forces, the confounding of issues, no cause-and-effect chain and confusion that surrounds organization;
- Ambiguity - the haziness of reality, the potential for misreads, and the mixed meanings of conditions; cause-and-effect confusion.

These elements present the context in which organizations view their current and future state (Wikipedia, 2020). They present boundaries for planning and policy management. They come together in ways that either confound decisions or sharpen the capacity to look ahead, plan ahead and move ahead. VUCA sets the stage for managing and leading.

The particular meaning and relevance of VUCA often relates to how people view the conditions under which they make decisions, plan forward, manage risks, foster change and solve problems. In general, the premises of VUCA tend to shape an organization's capacity to:

- Anticipate the Issues that Shape,
- Understand the Consequences of Issues and Actions,
- Appreciate the Interdependence of Variables,
- Prepare for Alternative Realities and Challenges,
- Interpret and Address Relevant Opportunities.

For most contemporary organizations – business, the military, education, government and others – VUCA is a practical code for awareness and readiness. Beyond the simple acronym is a body of knowledge that deals with learning models for VUCA preparedness, anticipation, evolution and intervention.

3 Trends in the digital transformation

Digital transformation is being spearheaded through a combination of software and hardware advancements. While the list of advancements is endless, the most promising technologies fall under one of the four umbrella terms described below briefly (Adamczewski, 2020; Lechmann, 2018; Olszak, 2018).

I. The Data Science Trio refers to three advancements related to data science that are arguably causing the greatest disruptions across various industries at present. These three technologies are:

- Data Analytics and Big Data Analytics refers to a set of qualitative and quantitative methodologies used to study and extract knowledge from raw data and use it to guide business decisions. Big Data refers to gargantuan data sets that contain important information and patterns hidden among large heaps of supplemental data. Both finite data analytics and big data analytics are applicable in virtually any scenario involving a database and sufficiently large amounts of data. Scores of companies are currently hiring armies of Data Analysts to crunch through their datasets and help them improve/organize their practices and services.
- Machine Learning refers to the concept of giving computers the ability to learn on their own without human intervention. The primary usage of machine learning is to teach computers to recognize patterns on their own in cases where human analysis

is too slow, expensive, or even impossible. Machine learning has thus seen itself being employed in recommendation engines, market analyses, spam filters, network security solutions, and more. Any organization that has data-based assignments which are large & repetitive (or) involve some form of identification tasks (or) a combination of both the above, should consider exploring machine learning solutions.

- Artificial Intelligence (AI) refers to a computer possessing the ability to perform a task or tasks in a manner that is just as effective or even more effective than a human being doing the same. While machine learning deals with a computer studying data and merely outputting what it has learned, Artificial Intelligence deals with a computer studying data and taking decisions/executing tasks based on certain pre-programmed instructions. A.I is best implemented in any scenario requiring high speed and high precision decision making and task execution.

II. Internet of Things (IoT) refers to a network of interconnected physical devices and sensors that collect data and exchange it with one another using the internet as a communication platform. IoT networks allow for low cost embedded systems to be deployed into physical environments where they can continuously collect information, relay it, interpret it, and act on it accordingly. IoT helps in achieving a scenario where all variables of a physical environment can be mapped and each constituent device's functioning can be made to depend on said variables or outputs from other device(s). For this reason, IoT has found immense value in health-care, smart cities, and smart homes.

III. Remote Work Environments. High skilled employees are very often not available at the desired location of a firm or may sometimes prefer to work from home. In the digital age, it makes no sense to compromise on talent by restricting hiring & work to a single physical location. Whether it is employees situated halfway across the world in a satellite office, or an employee situated half way across town in their own house, technological advancements such as video calls and internet-connected project management software allow us to send work to employees themselves when the reverse is not possible.

IV. Block Chain Technology. The finance industry is currently undergoing one of its largest transformations in history – thanks to blockchain. Blockchain refers to a distributed global database spanning across millions of computers all over the globe. It is not controlled by any central authority and uses state of the art cryptography to prevent

unauthorized access to sensitive information such as transaction history. Blockchains have already been implemented to create cryptocurrencies (e.g. Bitcoin) which are unregulated digital currencies that offer alternatives to traditional currencies. Cryptocurrencies are used widely due to the unmatched security and freedom they offer in trading any amount of money, big or small, without having to face any bureaucratic trouble.

V. Other Promising Trends. Beyond the technologies discussed above, there are several other technologies promising digital disruption of legacy industries. Some of the most promising trends are:

- Virtual Reality and Augmented Reality VR works by simulating entirely new environments digitally while AR works by imposing simulated elements onto real environments. Both VR and AR find already finding application in the fields of gaming, health-care, and warfare.
- Internet-Based Media & Advertising. Although internet-based media & advertising is already mainstream, most companies still prefer to spend more on print and TV platforms. As the world continues its tectonic shift to Internet-based consumption, firms such as Netflix and InMobi are already capitalizing lucratively on internet revenues for media and advertising content respectively.

4 Gartner Top Strategic Technology Trends

Technology trends IT can't afford to ignore in business. This year's trends fall under three themes: People centricity, location independence and resilient delivery (Gartner, 2020):

- People centricity: although the pandemic changed how many people work and interact with organizations, people are still at the center of all business. And they need digitaliized processes to function in today's environment.
- Location independence: COVID-19 has shifted where employees, customers, suppliers and organizational ecosystems physically exist. Location independence requires a technology shift to support this new version of business.
- Resilient delivery: whether a pandemic or a recession, volatility exists in the world. Organizations that are prepared to pivot and adapt will weather all types of disruptions.

As always, these nine strategic technology trends do not operate independently of each other, but rather build on and reinforce each other. Combinatorial innovation is an overarching theme for these trends. Together they enable organizational plasticity that will help guide organizations in the next five to 10 years.

Figure 1 Top Strategic Technology Trends for 2021. New York, p. 14., Source: Gartner (2020)

Trend 1: Internet of Behaviors (IoB)

As demonstrated by the COVID-19 protocol monitoring example, the IoB is about using data to change behaviors. With an increase in technologies that gather the "digital dust" of daily life - data that spans the digital and physical worlds - that information can be used to influence behaviors through feedback loops. For example, for commercial vehicles, telematics can monitor driving behaviors, from sudden braking to aggressive

turns. Companies can then use that data to improve driver performance, routing and safety.

IoB does have ethical and societal implications depending on the goals and outcomes of individual uses. The IoB can gather, combine and process data from many sources including: Commercial customer data; citizen data processed by public-sector and government agencies; social media; public domain deployments of facial recognition; and location tracking. The increasing sophistication of the technology that processes this data has enabled this trend to grow. IoB does have ethical and societal implications depending on the goals and outcomes of individual uses. The same wearables that health insurance companies use to track physical activities to reduce premiums could also be used to monitor grocery purchases; too many unhealthy items could increase premiums. Privacy laws, which vary from region to region, will greatly impact the adoption and scale of the IoB.

Trend 2: Total experience

Total experience combines multiexperience, customer experience, employee experience and user experience to transform the business outcome. The goal is to improve the overall experience where all of these pieces intersect, from technology to employees to customers and users. Tightly linking all of these experiences - as opposed to individually improving each one in a silo - differentiates a business from competitors in a way that is difficult to replicate, creating sustainable competitive advantage. This trend enables organizations to capitalize on COVID-19 disruptors including remote work, mobile, virtual and distributed customers. For example, one telecommu-nications company transformed its entire customer experience in an effort to improve safety and satisfaction. First, it deployed an appointment system via an existing app. When customers arrived for their appointment and came within 75 feet of the store, they received two things: 1) A notification to guide them through the check-in process and 2) an alert letting them know how long it would be before they could safely enter the store and maintain social distance. The company also adjusted its service to include more digital kiosks and enabled employees to use their own tablets to co-browse customers' devices without having to physically touch the hardware. The result was a safer, more seamless and integrated overall experience for customers and employees.

Trend 3: Privacy-enhancing computation

Privacy-enhancing computation features three technologies that protect data while it's being used. The first provides a trusted environment in which sensitive data can be processed or analyzed. The second performs processing and analytics in a decentralized manner. The third encrypts data

and algorithms before processing or analytics. This trend enables organizations to collaborate on research securely across regions and with competitors without sacrificing confidentiality. This approach is designed specifically for the increasing need to share data while maintaining privacy or security.

Trend 4: Distributed cloud

Distributed cloud is where cloud services are distributed to different physical locations, but the operation, governance and evolution remain the responsibility of the public cloud provider. Enabling organizations to have these services physically closer helps with low-latency scenarios, reduces data costs and helps accommodate laws that dictate data must remain in a specific geographical area. However, it also means that organizations still benefit from public cloud and aren't managing their own private cloud, which can be costly and complex. Distributed cloud is the future of cloud.

Trend 5: Anywhere operations

An anywhere operations model will be vital for businesses to emerge successfully from COVID-19. At its core, this operating model allows for business to be accessed, delivered and enabled anywhere - where customers, employers and business partners operate in physically remote environments. The model for anywhere operations is "digital first, remote first;" for example, banks that are mobile-only, but handle everything from transferring funds to opening accounts with no physical interaction. Digital should be the default at all times. That's not to say physical space doesn't have its place, but it should be digitally enhanced, for example, contactless check-out at a physical store, regardless of whether its physical or digital capabilities should be seamlessly delivered.

Trend 6: Cybersecurity mesh

Cybersecurity mesh is a distributed architectural approach to scalable, flexible and reliable cybersecurity control. Many assets now exist outside of the traditional security perimeter. Cybersecurity mesh essentially allows for the security perimeter to be defined around the identity of a person or thing. It enables a more modular, responsive security approach by centralizing policy orchestration and distributing policy enforcement. As perimeter protection becomes less meaningful, the security approach of a "walled city" must evolve to current needs.

Trend 7: Intelligent composable business

An intelligent composable business is one that can adapt and fundamentally rearrange itself based on a current situation.

As organizations accelerate digital business strategy to drive faster digital transformation, they need to be agile and make quick business decisions informed by currently available data. To successfully do this, organizations must enable better access to information, augment that information with better insight and have the ability to respond quickly to the implications of that insight. This will also include increasing autonomy and democratization across the organization, enabling parts of the businesses to quickly react instead of being bogged down by inefficient processes.

Trend 8: AI engineering

A robust AI engineering strategy will facilitate the performance, scalability, interpretability and reliability of AI models while delivering the full value of AI investments. AI projects often face issues with maintainability, scalability and governance, which makes them a challenge for most organizations. AI engineering offers a pathway, making AI a part of the mainstream DevOps process rather than a set of specialized and isolated projects. It brings together various disciplines to tame the AI hype while providing a clearer path to value when operationalizing the combination of multiple AI techniques. Due to the governance aspect of AI engineering, responsible AI is emerging to deal with trust, transparency, ethics, fairness, interpretability and compliance issues. It is the operationalization of AI accountability.

Trend 9: Hyperautomation

Hyperautomation is the idea that anything that can be automated in an organization should be automated. Hyperautomation is driven by organizations having legacy business processes that are not streamlined, creating immensely expensive and extensive issues for organizations. Many organizations are supported by a "patchwork" of technologies that are not lean, optimized, connected, clean or explicit. At the same time, the acceleration of digital business requires efficiency, speed and democratization. Organizations that don't focus on efficiency, efficacy and business agility will be left behind.

5 Conclusions

The dynamic economic changes in VUCA-Environment and the evolution of business relationships devaluate traditional sources of competitive advantages in the enterprises, such as capital, infrastructure, access to outlets, and the quality of offered products and services. Modern enterprises that want to compete on the market effectively have to give priority to flexibility

of their organization and its ability to implement innovative business models and reorganise logistics processes. Examples of numerous enterprises show that the vision of a business managed in a modern way has come into the dynamic phase of realization, while the effective knowledge management with advanced ICT solutions is growing to the role of paradigm. There is no doubt that reserves still present in the enterprises can be utilised, through supporting its operation with advanced ICT systems with the dominant role of SMAC, IoT and AI solutions. Nevertheless, it has to be remembered that the creation and development of such smart technologies has one basic aim for businesses, namely to accelerate the development pace and improve the quality of offered products and services, while reducing operating costs.

The SMAC-Solutions opens up a new frontier for digital business. This is because virtually every application, service and IoT object incorporates an intelligent aspect to automate or augment application processes or human activities.Digital representations of things and organizational processes are increasingly used to monitor, analyze and control real-world environments. These digital twins combined with SMAC, IoT, AI and immersive experiences set the stage for open, connected and coordinated smart spaces. Formal mechanisms to identify technology trends and prioritize those with the biggest potential impact on the business create competitive advantage.

The need to improve the digital resiliency of the workforce during and after the COVID-19 pandemic has drastically accelerated trends in digital workplace technology. When employees were sent home from their offices en masse amid the global onset of COVID-19, many businesses scrambled to adopt technology solutions to enable their teams to work remotely. ICT leaders have now realized the urgency to scale up their digital workplace technology stacks to ensure the long-term resiliency of their business. The pandemic rapidly elevated many digital workplace technologies from nice-to-have to must-have status.

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Edvantages of Electronic Document Circulation in the Condition of Digital Economy

Ruslana Andrushko[1]

Abstract. Businesses around the world with the help of information technology are trying to optimize modern document circulation and reduce time and resources. To implement electronic document circulation in the enterprise it is necessary to take into account both the peculiarities of doing business and the general legal requirements for the creation, receipt, processing and storage of electronic documents. The main advantages of using electronic document circulation of enterprises and institutions are special software with the generation of electronic signatures and conditionality of mutual recognition of Ukrainian and foreign public key certificates

Keywords: electronic document circulation, electronic digital signature, e-government, accounting systems, electronic reporting and exchange of electronic documents.

JEL Classification: Q40

1 Introduction

Electronic document circulation has emerged as a cost-effective and environmentally friendly alternative to paper. With the help of information technology, companies around the world are trying to optimize their work, reducing operating costs, in addition, it is fast and convenient.

Andrushko R. and Lysa O. (2018), note that the problems of implementing electronic document management relate not only to the lack of methods, but also the inconsistency of a significant number of regulatory assets to work with electronic documents and relations in the field of information technology.

The transition from paper to electronic document circulation is a gradual process, it begins with the willful decision of management.

[1]Lviv National Agrarian University, department of Accounting and taxation, 1,VolodymyraVelykogost., Dubl'iny, 80381, Ukraine, andrp1992@ukr.net

And the timing of this transition depends on the scale and characteristics of the entity.

That is, the business entity has the right to use in its activities documents in electronic form in compliance with the Laws of Ukraine № 851 and № 2155 (2), which regulate relations related to electronic document circulation and use of electronic documents. Electronic document circulation (circulation of electronic documents) - a set of processes for creating, processing, sending, transmitting, receiving, storing, using and destroying electronic documents, which are performed using integrity checks and, if necessary, confirming receipt of such documents (Article 10 of the Law № 851) (1). Law № 851 defines an electronic document as follows: "it is a document in which information is recorded in the form of electronic data, including mandatory details". An electronic document can be created, transmitted, stored and converted electronically into a visual form. The transmission of an electronic document may be carried out in electronic form by means of information or telecommunication systems, as well as by the transmission of electronic media (disk, flash drive, etc.) on which the document is recorded.

2 Advantages of electronic document circulation in the condition of digital economy Ukraine

To implement electronic document management, the company must independently develop the procedure for such document management, taking into account the specifics of doing business (eg, the procedure for receiving incoming correspondence, processing, verification of electronic documents) and general legal requirements for creating, receiving, processing and storing electronic documents.

There are no restrictions in the legislation of Ukraine on the use of a single program at the enterprise, which allows to create electronic documents.

The modern market of computer accounting systems is developing mainly in three directions:

1) traditional accounting systems (system "I C: Enterprise", "Sail" and others);

2) systems for providing electronic reporting and exchange of electronic documents ("M.E.Shs", "Art-Report Plus" and others). These programs provide the imposition of electronic digital signatures (EDS), submission of electronic reports to government agencies and the exchange of electronic documents with contractors;

3) software services for accounting using the achievements of network and Internet technologies, in particular: Master: Accounting, "Accounting 8aa8", "iRip", "SMART accounting"). They allow you to work in both stationary and cloud access. Ivakhnenkov S. (2003) digital accounting software is most often grouped into: home accounting and private business; mini-accounting; universal accounting systems; local workstations; complexes of connected workstations; management systems (ERP class systems - Enterprise resources planning); consolidated reporting programs; financial and analytical systems; legal databases.

Therefore, different configurations have application solutions by industry and task. Thus it is possible to automate a separate site, or to solve accounting problems taking into account branch specificity.

A group of software products offered by manufacturers for work via the Internet is gaining popularity among users. When it is not the software that works, but the service for using the accounting program, ie in the cloud. The program is available anytime and anywhere with a stable Internet channel, which allows you to work remotely. Klym N.M. and Hrytsak O.S. (2018) indicate that these technologies provide data protection, and when using them does not matter the degree of branching of the organization and the number of affiliates.

In the digital economy, electronic document circulation should ensure the formation of the following documents: organizational and administrative, scientific and technical, primary, banking, financial, special documentation and reporting, statistical and tax, which will help solve not only analytical and accounting problems, but also management, Figure 1.

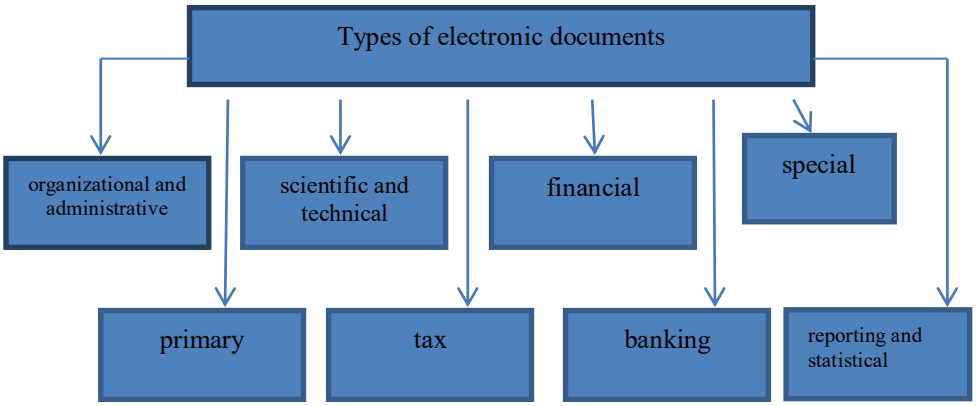

Figure 1. Types of electronic documents**.** Source: own.

The electronic document ends with the imposition of a digital signature, which is a mandatory requisite and is used by individuals and legal entities - subjects of electronic document circulation to identify them and confirm the integrity of data in electronic form.

It should be noted that the Law of Ukraine "On Electronic Digital Signature" № 852 has expired, and since November 7, 2018 the Law of Ukraine "On Electronic Trust Services" (hereinafter - the Law №2155) has been in force. This Law introduces such digital mechanisms as: electronic identification, electronic signature, electronic seal, electronic timestamp, registered electronic delivery, etc. One of the most important provisions of Law № 2155 is the mutual recognition of Ukrainian and foreign certificates of public keys and electronic signatures.

According to Part 2 of Art. 22 of the Law № 2155 identification of a natural person who applied for the service of forming a qualified public key certificate is subject to his personal presence on the passport of a citizen of Ukraine or other documents that prevent any doubts about the person, according to the legislation on the Unified State demographic register and identity documents confirming the citizenship of Ukraine or the special status of the person.

In addition, an administrative service is being introduced to include legal and natural persons - entrepreneurs who intend to provide electronic trust services (ETS) in the Trust List, and the procedure for maintaining

such a list is established. Also, the procedure of independent conformity assessment for ETS is determined, as well as the possibility for these persons to use both national and international standards in their activities.

Thus, for the organization of internal electronic document management, the company needs to purchase special software for generating electronic signatures.

Electronic document circulation is based on the following advantages:

- prompt access to documents;
- effective document flow management;
- increase discipline and productivity;
- security and preservation of documents;
- reduction of financial costs for document management and office work;
- improving the procedure for preparation, submission, accounting and storage of documents, their authentication, integrity, confidentiality and irrefutability;
- fast and reliable exchange of electronic documents with partners, contractors and government agencies.

Of course, this is not the whole list of benefits.

When organizing any document flow, we recommend entering the following additional details for electronic documents: a note on the use of the document indicating the official who opened the document, the date and time of use; a note on the change of the document with indication of the employee's data, date and time, as well as information on what exactly was changed in the document; links to supporting documents.

Electronic document circulation applies not only to enterprises but also to public authorities. Thus, within the framework of the implementation of the National Informatization Program, the creation of an integrated e-document management system is envisaged, which should ensure the circulation of documents and reduce the time of preparation and decision-making by public authorities.

In this regard, the definition of the term "e-government" is often used, which has no clear definition and provides for the possibility to pay a fine

online, register a business or take a place in the electronic queue for a passport, etc.

Thus, the development of modern information technologies and the current legal framework have forced companies and institutions to introduce electronic document management. Electronic document circulation is a system that materializes the processes of collecting, transforming, storing information, as well as improving the preparation and management of decisions and control over their implementation.

3 Conclusion

The introduction of an integrated electronic document circulation system will significantly improve these procedures, so its purpose and role as an element of e-government are already extremely important today. Therefore, problems are not excluded due to the possibility of unauthorized access to information, unqualified actions of users, technical problems and viruses.

Developers of integrated accounting automation software create separate analytical programs, compatible with their own accounting programs, which allow analysis based on accounting data and financial statements generated by accounting software. Therefore, 1C software products to increase business efficiency allow you to work with operational information that characterizes the current state of the enterprise at a given time and allow you to quickly and conveniently receive reports for management decisions at various levels.

The era of the XXI century radically changes the approach to doing business and the requirements for accounting, document management, control, business communication and many other attributes, which argues the need for digital transformation of Ukraine's economy.

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Design of Low-cost Laboratory Task for Teaching IoT

Roman Danel[1, 2], Jakub Chlopecký[3, 4]

Abstract. The concept of the Internet of Things as a network of devices connected and communicating using various protocols over the Internet originated about twenty years ago. Today, it is a commonly used technology, even in industry. The article describes the design of a laboratory task, enabling the teaching of the concept of the Internet of Things. The idea was in connecting sensors to the control system via the Internet using the MQTT protocol, two-way communication with connected devices, data collection and their visualization. One of the design criteria was the minimization of costs and the use of standard commonly available software and hardware. The proposed task was realized and tested during the course "Introduction to IoT" at WSG University in Bydgoszcz.

Keywords: Internet of Things, MQTT protocol, esp8266, Node-RED, SCADA, Promotic

JEL Classification: D8, A2

1. Introducton

The Internet of things (IoT) is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

The term "Internet of things" was likely coined by Kevin Ashton of Procter & Gamble, later MIT's Auto-ID Center, in 1999, though he prefers the phrase "Internet for things". At that point, he viewed radio-frequency identification (RFID) as essential to the Internet of things, which would allow computers to manage all individual things.

[1] VŠB – Technical University of Ostrava/Faculty of Economics, Department of Applied Informatics, Ostrava, Czech Republic, roman.danel@vsb.cz
[2] University of Economy in Bydgoszcz/Department of informatics and mechatronics, Bydgoszcz, Poland, roman.danel@byd.pl
[3] VŠB – Technical University of Ostrava/Faculty of Mining and Geology, Department of Economics and Control Systems, Ostrava, Czech Republic, jakub.chlopecky@vsb.cz
[4] MVŠO, o. p. s., Olomouc/Institute of management and marketing, Olomouc, Czech Republic, jakub.chlopecky@mvso.cz

The aim of this article is to describe a method for teaching the architecture and usage of IoT.

2. Literature review and methodology

The article (Nelke and Winokur, 2021) explains how education in the Internet of Things (IoT) area is introduced into the training by the Department of Technology Management at the Holon Institute of Technology, Israel. (Singh and Kumar, 2021) discuss the design and construction of a smart irrigation system, sensor-based system powered by an Internet of Things (IoT) chip (ESP8266). The paper (Jain and Chawla, 2021) explains the basics of IoT and aims at highlighting all the practical methods for integrating IoT features in education. (Kavka et al, 2019) published the analysis of logistics processes according to the Industry 4.0 concept. The aim of the paper is to show the application of this approach in the teaching of subjects focused on logistic processes.

The IoT concept provides for substantially wider integration possibilities concerning key information needed for control, as well as availability of such information for further application. An important part of the overall system design is the presentation layer, which asks for processing of clearly presented, synoptically easy to take information flows. As such, providing for a sophisticated visualization of information is a prerequisite for the system functional success. The key idea of IoT is an on-line Internet cross connection of information systems, computers, technical equipment, etc., in a unified system (Kodym, Danel and Kohut., 2013). Within the Internet of Things, both information from the production process, information from operational deployment and information on the termination of the object existence are interconnected (Kodym et al, 2013).

Experience with teaching programming languages was analyzed in (Danel, Vojtek and Ministr, 2018). The article analyzes the requirements of practice for IT graduates, the view of graduates on the lesson and discuss on how to teach programming.

In designing the task presented in this article, lessons from teaching, discussions with graduates and knowledge from articles published on the topic of education related to IoT were used.

3. Description of the solution

To a laboratory task for teaching the Internet of Things the following subtasks were identified:

- Selection and commissioning of a platform for connecting devices and sensors
- Selection of suitable sensors
- Design of a task for data collection from sensors
- Solution for connecting the communication platform via Wi-Fi to the Internet using suitable communication protocols
- MQTT communication protocol for data transmission based on messaging
- Client for verifying communication via MQTT
- Task for automated data collection from sensors via the Internet using MQTT
- Storing data from the MQTT in a database
- Visualization of data from sensors in real time, e.g. SCADA system

Based on the analysis above, the design of the laboratory task is shown at the Figure 1.

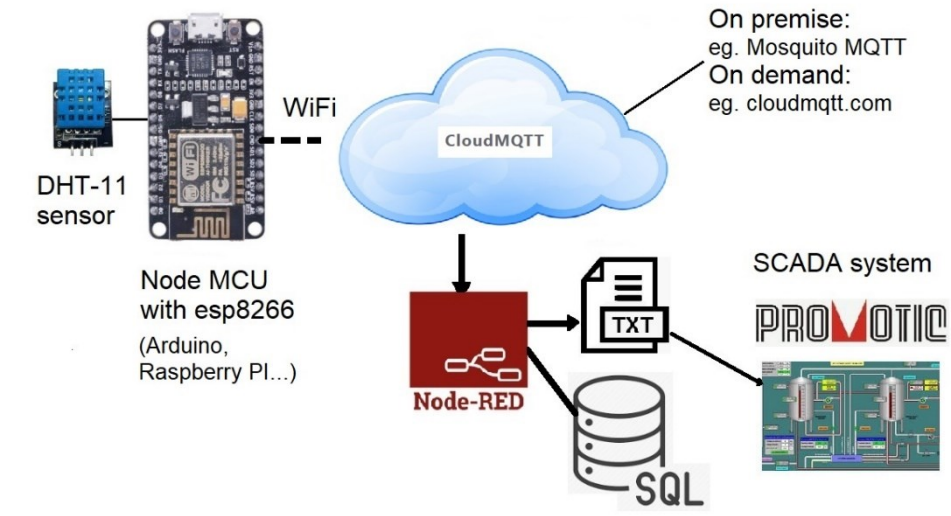

Figure 1 Scheme of laboratory task for teaching IoT. Source: own

The technical means used, including costs, are listed in Table 1. To the costs must be added the costs of cabling (connection of sensors and USB cable for connecting the NodeMCU to a computer enabling job upload) and costs of a breadboard.

Table 1 Table 1 Selected means and its prices

Element of the task	**Solution – device or sofware**	**Prize**
Device for connecting sensors	NodeMCU with esp8266	5 - 7 €
Sensors	DHT-11 HC-SR505 – PIR sensor	2 € 2.5 €
Software for design	ArduinoIDE	Free
Cloud service with MQTT	http://www.cloudmqtt.com CuteCAT	Free, limited per 5 connections
Client for MQTT	Node-RED	Free
Data visualisation	SCADA system PROMOTIC	Free with limit of 30 dynamic data sources

The NodeMCU board with the system-on-a-chip microcontroller esp8266 is fully compatible with the popular single-board computer Arduino and it is possible to use the development environment ArduinoIDE for application programming. Another option is to program applications using the Lua programming language. The difference compared to the Arduino is in the used voltage of 3.3 V on the board esp8266, to which the connection of some sensors must be adapted. The conversion of 5V voltage from the USB port is provided by the NodeMCU board. The esp8266 microcontroller is equipped with a Wi-Fi module and can therefore be connected directly to the Internet. There is also available a library for ArduinoIDE for sending and receiving messages via the MQTT protocol.

A large number of commonly available sensors can be connected to the board, which can be purchased at low cost, so a large number of tasks can be prepared for use in teaching. These tasks consist of mastering sensor connections, reading information from sensors (or sending control commands) and sending pre-processed data via the MQTT.

The MQ Telemetry Transport protocol (MQTT) is one of the most widely used protocols in IoT applications. MQTT was created in 1999 by Andy Stanford-Clark (IBM) and Arlen Nipper (Eurotech). MQTT is the machine-to-machine protocol.

Figure 2 Scheme of sending a message using MQTT protocol

Message queues provide an asynchronous communications protocol, the sender and receiver of the message do not need to interact with the message queue at the same time. Messages placed onto the queue are stored until the recipient retrieves them or until the message times out.

MQTT is based on the Publish-Subscribe pattern. In this architecture (Figure 2), messages sent by senders (publisher) go to the intermediary server (broker), and not directly to recipients (subscriber). The recipient receives messages that he is actually interested in, he knows nothing about the sender. The sender also does not know which recipient will receive the message. It is also unknown whether anyone will receive the message. With such a communication solution there is no so-called pooling, i.e. cyclic querying the server whether new data appeared (query => answer) - the server will inform interested customers about the new message.

Broker is responsible for delivering messages. The most popular borkers are Mosquitto, HiveMQ or RabbitMQ. It is possible to run an on-promise solution on own server or use some of on-demand cloud services. For prepared laboratory task was suggested to use on-demand cloud service http://www.cloudmqtt.com, which offers user plans on several levels, from "Cute CAT" for free to plan focused on the enterprise solution (300 USD /month, with up 10,000 connections). Free plan used in presented solution is limited to 5 connections only and does not guarantee high availability, but for teaching purposes is suitable.

For testing the communication via the MQTT protocol, was used Chrome MQTTLens. It is a Google Chrome application (add-on), which connects to a the MQTT broker and is able to subscribe and publish to MQTT topics.

A client application called Node-RED has been used for continuous collecting data from the MQTT broker. Node-RED is an open-source flow-based tool and IoT platform and dashboard developed by IBM and written in Node.js. The Node-RED is available at https://flows.nodered.org/ and a guide how to install and run this software is available at https://nodered.org/docs/getting-started/windows. After running node-RED in the console we have access to the environment in the browser on the localhost:1880 port. To design flows, we visually combine different nodes that perform specific functions or send messages. There are input blocks that send messages, output blocks that receive messages, and functions that process messages (they have input and output). The message can be initiated in various ways, e.g. by reading Modbus commands, reading MGTT messages, or simply initiated through another block.

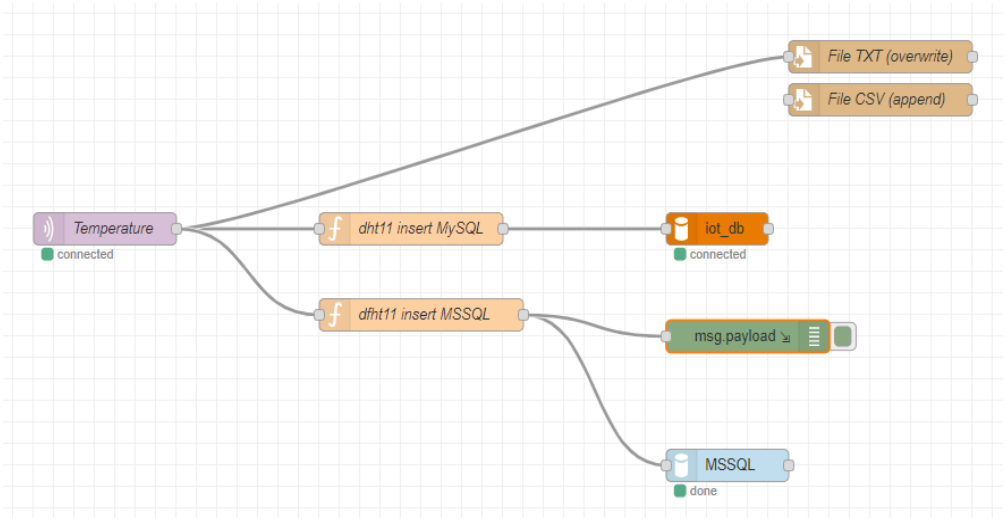

Figure 3 Example of a flow in the Node-RED – writing received MQTT messages into flat file and into MySQL or Microsoft SQL Server

The Temperature node in example at Figure 3 retrieves data from the MQTT broker using the Subscribe method. Function node creates SQL insert command from received message (in msg.payload node property) using JavaScript. Output from this node is connected to the MySQL and MSSQL nodes for writing data into the database. A green "connected" icon notifies that the node is properly configured and working.

Every node should be properly configured. An example of a node setting is shown at Figure 4 and an example of a MQTT broker connection

setting at Figure 5. Every message sending via the MQTT protocol has a unique name called “topic”. Quality of service can be set to 0 (a sent message does not need confirmation of delivery, we send and forget), 1 (a sent message must be delivered at least once) or 2 (this level guarantees that the message will be delivered exactly only once).

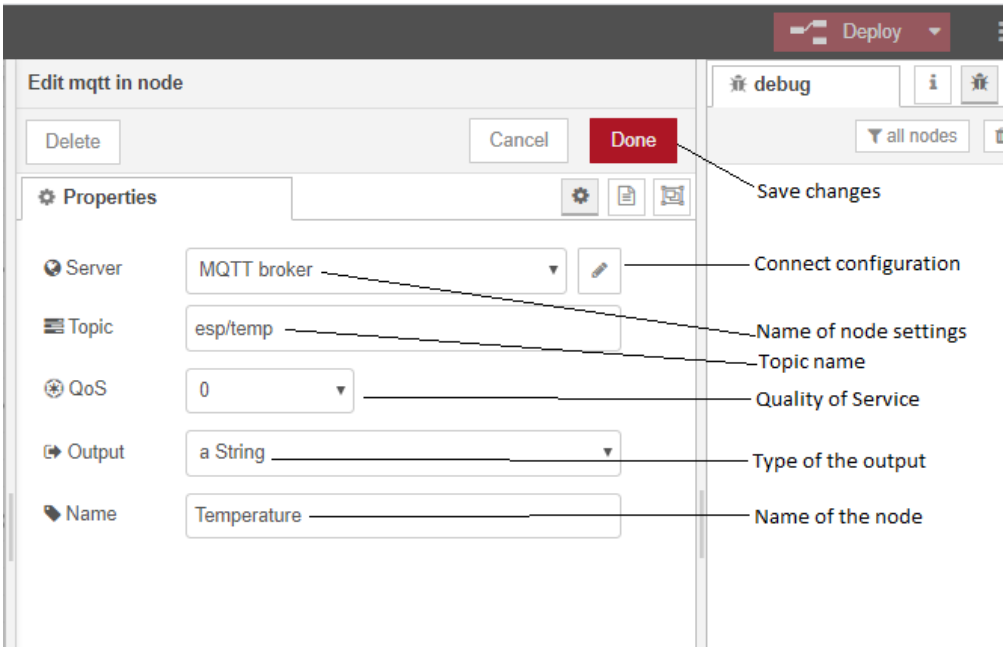

Figure 4 Example of setting a Node-RED node

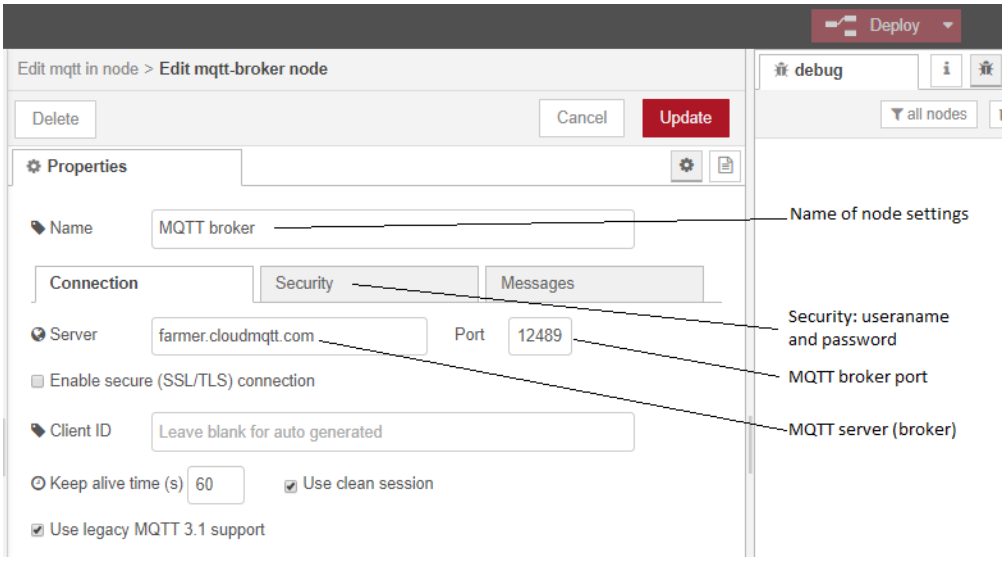

Figure 5 Example of configuring a MQTT broker connection

There is also a MQTT client for mobile phones (Android and Mac) that allows you to send and receive messages through a MQTT broker. The task can therefore be extended to create a mobile application that monitors or controls devices in a IoT network.

For final data visualisation in real time, was chosen a SCADA system. For purpose of teaching, was used the SCADA system from Microsys Ltd. called Promotic. This software is commercial and required a licensed key but it is also available as a freeware - downloadable and functional free of charge. In the freeware mode, it is possible to use all communication drivers and interfaces that are available in the commercial mode. The runtime of freeware applications is not limited. The only limitation of the freeware mode is the maximum amount of up to configure 30 dynamic variables (this mean that is possible to connect maximum 30 data sources). Promotic is available for download at: https://www.promotic.eu/en/promotic/download/download.htm and is offered in several language versions. Since autumn 2020 Microsys launched a new version of Promotic, which contains functions for direct connection to a MQTT broker.

4. Discussion and conclusion

Proposed design allows you to prepare laboratory tasks at low cost, which will allow students to assemble and program tasks from the IoT category, including communication via the MQTT protocol and visualization of acquired data in real time.

The proposed task was tested at WSG (University of Economy in Bydgoszcz, Poland) during teaching the subject "Introduction into IoT". A classroom with the required hardware was created for 25 students and several types of sensors were purchased. The fact that students were able to try the studied theory practically increased their motivation and desire to learn.

Acknowledgements

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Organizational and social dimensions of the 21st century cybereconomy

Anna Pietruszka-Ortyl[1]

Abstract. The dawn of the new millennium became the focal point of all changes emerging at the end of the last quarter of the 20th century. The emerging trends crystallized and the presented forecasts and initiated phenomena were confirmed. A new reality emerged, in which different rules of economic activity and different rules for societies began to apply. The knowledge-based economy has entered the next phase of development. The digital revolution has emerged as the Society 5.0, consisting mainly of intellectual workers, started to follow the idea of sharing, embedded in cooperation, interdependence and shared responsibility. All objects, in every sphere of life, became entangled, and metaphor became a popular means of expression. The main challenges of human and economic activity have become part of the knowledge – network – cooperation triad.
The article is theoretical study and focuses on presenting the transformations of the new reality in the 21st century. It discusses the evolution of economies and societies towards the cyber-smart civilization of the new millennium.

Keywords: 4-6 Revolution 4.0, Society 5.0, knowledge-based economy.

JEL Classification: D24, D83, F63, J24

1 Change of business conditions in the new millennium

Contemporary organizations came to function in unusual circumstances. The end of the 20th century brought about significant transformations in many areas. As the "global village" emerged, people started to live in an all-computerized environment, which impacted their lifestyles. The e-society was ultimately followed by the network society. As national economies opened up, intensive internationalization processes began, and a global economy was established. Organizations intensified their efforts to function in multidimensional and multilateral cooperative partnerships.

[1] Cracow University of Economics, College of Management and Quality Sciences, Department of Organizational Behavior, 31-510 Kraków ul. Rakowicka 27, pietrusa@uek.krakow.pl.

As a result, a new reality has emerged, with different characteristics. Most often, it has been called the new economy, or knowledge-based economy[2] . Due to its network-like nature (Tkach, 2019, p. 234), knowledge took the first place in the pantheon of intangible resources (see (Jacobsen, Hofman-Bang, Nordby Jr, 2005; Horzela, Ambrochowicz, 2019; Latif, Afzal, Saqib, Sahibzada, Alam, 2020]), as it was considered to be the driving force behind the development of human civilization in all its aspects (see (Argote, Ingram, 2000; Mehralian, Nazari, Ghasemzadeh, 2018; Sagan, 2020)). Knowledge became the carrier of the 21st century economy and the catalyst for major structural changes in the economic environment (see (Morris, 2010; Harris, 2016)). The ubiquitous technological innovations that emanate knowledge have transformed business processes and the resulting products and services (see (Harris, 2016, p. 12; Gartner, 2019; Szelagowski, Berniak-Woźny, 2020; Sobolewska, 2020)). The ongoing technical progress and the civilizational changes resulting from it are therefore continuous, evolutionary in nature and subject to dynamic acceleration (Złowodzki, 2019). Additionally, knowledge has been professionalized. A new class of specialists operating in the knowledge-intensive sectors has appeared (Mehralian, Nazari, Ghasemzadeh, 2018).

These transformations in the world's operating conditions in the 21st century, and thus in its ways of functioning, are reflected in the new nomenclature. To distinguish the current reality from the previous, traditional one, it is defined not only as a knowledge-based economy, but also as the economy of "benefits", or rather of "excess" (Skrzypek, 2004, p. 75), as digital, gig, online , networks, creative, or "on demand" economy (Janowska, Skrzek-Lubasińska, 2019, p. 58). The network society which functions in this economy (Castells, 2013) is called "risk", "service" and "show" society (Skrzypek, 2011, p. 271), in which the mass media, as a source of information, have become one of the most important actors in public life (Potocki, 2019, p. 14).

"The 6th Generation" era has come, in which the main organizational asset was successively: the product, the project, the organization,

[2] These terms came into common use since the late 1990s, as defined by the OECD (1996, p. 7). Nevertheless, these terms should be treated more as a metaphorical construct, which symbolically describes the specific conditions of contemporary operations than a fully coherent concept of analytical value (see (Brinkley, 2006; Dagelsegger-Màrguez, Remøe, Trienes, 2018)).

the customer, knowledge, and finally, the future (see: (Amidon, 1996, p. 7; Edvinsson, Dvir, Roth, Pasher, 2004, p. 40-41)). In the current framework, the main asset is the ability to read low-signal impulses that induce vibrations of the network of interdependencies, as well as proper forecasting of the consequences of these vibrations and proper preparation for them. So, in essence, to create the future is to generate these signals.

The aim of the paper, based on a systematic, critical analysis of the subject literature, is a synthetic presentation and modeling the evolution of economies, industries and societies towards a new construct: the smart cyberspace civilization, the 21st century cybereconomy.

2 Evolution of the Knowledge Age in the context of industrial revolutions

While the emergence of the new knowledge-based economy occurred at the end of the 20th century, at the turn of the century there was a transition from the Early to Late Knowledge Age. This resulted in the evolution and co-existence of various sub-economies (information, learning, innovative, creative, network, sharing or green economies) (Fig. 1). Hence, the knowledge-based economy is not homogeneous. Within such a metaphorically understood construct, individual subcategories of the economy of knowledge are identified.

The Post-Industrial Era was launched with the arrival of the information economy (Podluzhna, 2017), which evolved into the learning economy (Lundvall, 1997, 2016), the character of which is related to the continuous "learning to learn" (Stiglitz, 1987; Pavitt, 2002) at all levels (Cotsomitis, 2017) and is based on the development of mental models that naturally encourage the use of new knowledge and induce quick adaptation to changes (Dohmen, 1999; Tkach, 2019). As a consequence, the economy of innovation emerged, resulting in long-term economic development and an increase in the quality of life in societies (Courvisanos, MacKenzie, 2014; Wojnicka-Sycz, Sycz, 2016).

orientation on information, knowledge and intellectual capital,
economic growth and value creation
increase in competitiveness and development of innovation

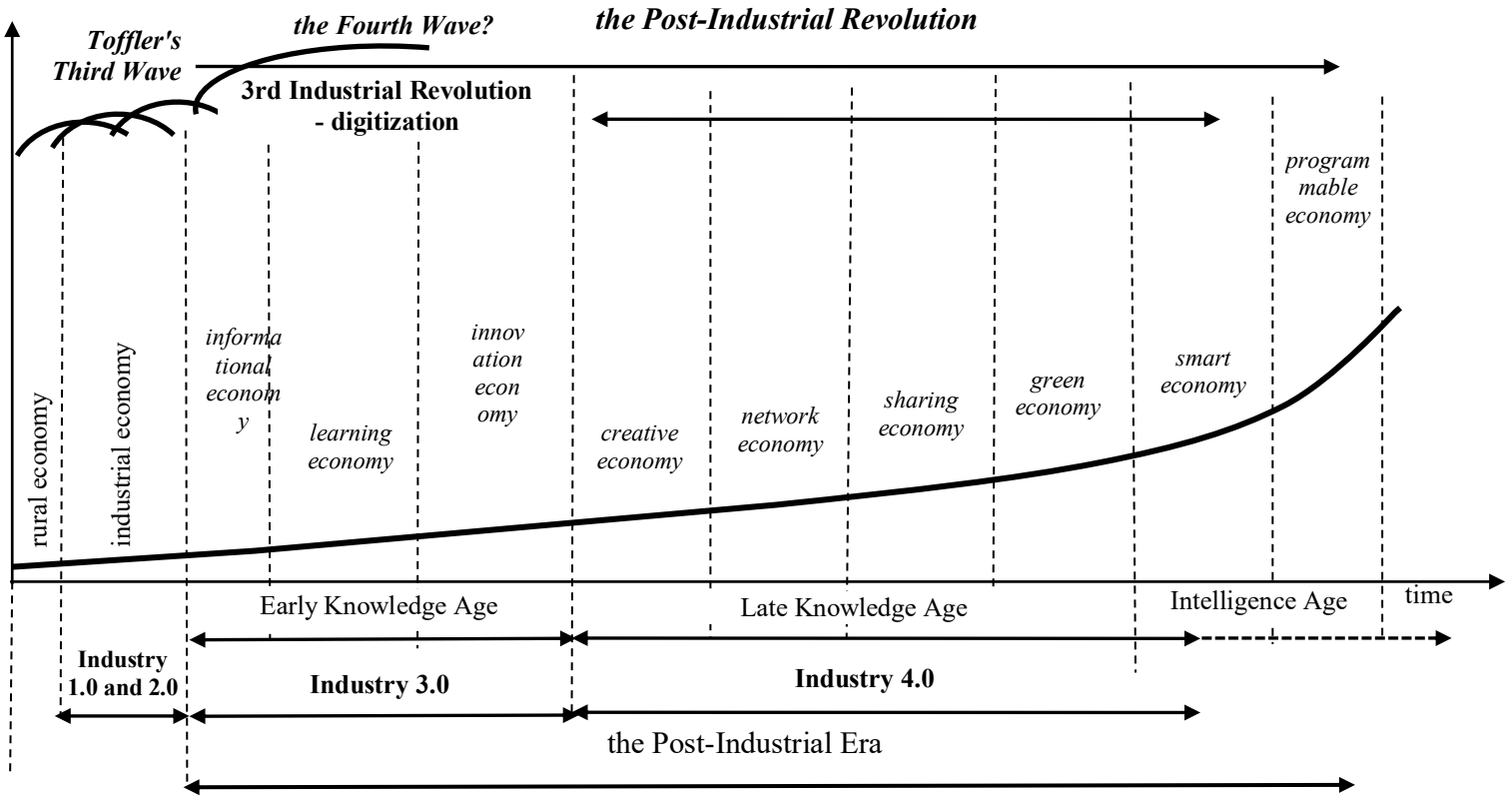

Figure 1. The Knowledge Age vs. the phases of economic development and subsequent industrial revolutions
Source: own study based on: (Podluzhna, 2017; Gorustowicz, 2019; du Vall, 2019; Złowodzki, 2019).

It was then that the economy of creativity emerged (Howkins, 2007), in which flexibility, agility, resilience and creative thinking were adopted as key factors of development (Schiuma, 2014). Categories related to human capital, e.g., talents, innovation, openness or technological efficiency became its measures of growth (Ndou, Schiuma, Passiante, 2019).

One of the basic determinants of functioning in the network economy is the transition from the transactional perspective to the relational perspective. This is because global, platform-based digital connections and activities based on long-term and stable relationships between economic entities has become the network economy's principal domain of interaction. In the case of connections, the term network refers to a new, technical form of dependence, and in the case of relationships, to the character of interactions between the members of the formation (Sekreter, 2017; Ustyuzhanina, Evsukov, Komarova, 2018).

The inclusion of many diverse stakeholders operating at different levels of socio-economic life, within the global electronic network, leads to forming a shared vision of the future (du Vall, 2019). Thus, at present, another sub-economy of the knowledge economy is emerging, i.e. the sharing economy (Wosskow, 2014; Harris, 2016), which includes economic practices oriented at exchange outside the market and the shared use of goods (Zysk, 2016). Therefore, it emphasizes trust and cooperation in the community created by participants of the exchange (Baranowski, 2019).

In turn, the depletion of natural resources and the need to rationalize their management resulted in a reorientation: from intangible resources to natural ones. Thus, the green economy emerged (Pearce, Markandya, and Barbier, 1989), which manifests itself in special care for the natural environment, a rational use of its resources and recycling. It is intended to be low-carbon, resource-efficient and support "social inclusion" (Żak, 2015; Podluzhna, 2017).

The coexistence of individual sub-economies of the knowledge economy has led to the emergence of another type of economy - the smart economy, which is likely to usher in a new era - the era of smart human behavior and artificial intelligence of learning machines. Smart economy will be based on technologies that have not been invented yet, and its main guidelines will be related to generating maximum benefits for all mankind,

including improving the quality of life of societies and the planet, using smart technologies. This includes taking actions stimulating innovation and creativity in combination with scientific research, new generation technologies and natural environment protection expressed in the concept of sustainable development (Apostol, Bălăceanu, Constantinescu, 2015).

The growing role of artificial intelligence, learning machines and cryptocurrencies will, in turn, transform the classic concepts of exchange, especially monetary, or of relations between humans and smart machines. This will lead to the emergence of a technology exceeding the potential and capabilities of the modern internet, which will allow defining the input system parameters in such a way to generate the planned and desired result with real-time monitoring and simulation. The economy will therefore be programmable in such a way to benefit a maximum number of people, in the minimum time, at optimal costs, in a sustainable manner (Hegadekatti, Yatish, 2017; Podluzhna, 2017).

Parallel to the occurring economic changes, the socio-economic systems were changing (Fig. 1). The third wave of human evolution (Toffler, 1997), which was a continuation of the Industrial Revolution (Złowodzki, 2019), fostered the creation of automated production in smart factories using cyber-physical systems. These transformations are referred to as the Third and Fourth Industrial Revolutions, resulting in the creation of Industry 3.0 and Industry 4.0 (Gorustowicz, 2019). The Fourth Industrial Revolution is usually treated as a concept, which generalizes the mutual use of automation, data processing and exchange, as well as manufacturing techniques. It is a reality in which computers, the internet, the World Wide Web and social media transform the service society characteristic of the knowledge economy into a digital society of the new era (Janowska, Skrzek-Lubasińska, 2019).

Ultimately, more and more new factors and operating circumstances closely related to digitization and artificial intelligence are emerging. The Smart Age is coming, understood as the resultant of human intelligence and artificial intelligence of digital machines. Its objects are self-improving, able to identify and communicate with each other, oriented towards vertical and horizontal networking of different components and other machines via internet protocols.

3 The social context of industrial revolutions - the smart cyberspace civilization

The development of industry, marking particular eras in the evolution of economies, also brought about fundamental civilizational transformations, reflected both in the lifestyle and in mentality (Fig. 2).

The evolution of economies brought about the functioning of humans in a cybernetic space based on a digital network. Thus, Civilization 4.0 was born. As the exchange and processing of information with the use of modern IT technologies become the foundation of all human activity in the information society (Miczyńska-Kowalska, 2019), a technologically interconnected information society (Baranowski, 2019) emerges. The society has specific attributes; it is based on generating knowledge and processing information using microelectronic-based IT, it is organized in a network, and its core activities are formed into a global network. Its basic components are networks, heterogeneous sets of organizational elements. Access to information allows them to organize themselves into homogeneous non-hierarchical task structures operating online (Potocki, 2019, p. 23-24). An inherent feature of such a society is a lifelong learning (Cotsomitis, 2018; Tkach, 2019). It is also described as informationized because it processes more information and does it in a more sophisticated way. The process of informationization includes the democratization of cultural participation, education that increases information processing skills and the existence of social media (Kryszczuk, Szymański, 2019, p. 122).

There is already a gradual evolution of Society 4.0 towards Society 5.0. The new Civilization 5.0 responds to the basic threats of the knowledge-based economy, and the greatest challenge of the future is to invent and design the lifestyle of this civilization (Tkach, 2019). It is primarily intended to eliminate unfavorable phenomena encountered in the reality of the information community. The proposed course of changes includes (du Vall, 2019, p. 28):

– liberation from the paradigm of the economies of scale (from the economies of scale in Society 4.0 to problem solving and value creation in Society 5.0),

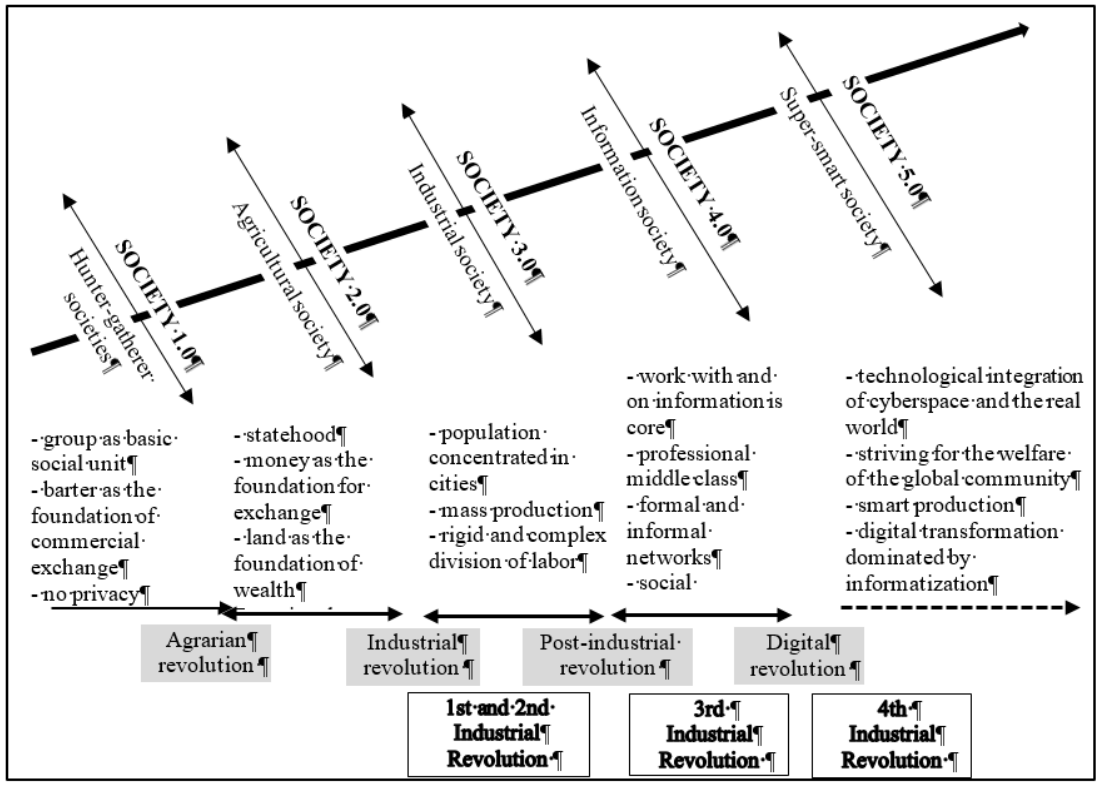

Figure 2. Evolution of societies in the context of economic revolutions
Source: own study based on: (du Vall, 2019; Potocki, 2019; Złowodzki, 2019)

- liberation from the suppression of individuality (from the uniformization of Civilization 4.0 to the diversity of Civilization 5.0),
- liberation from inequalities and disproportions (from concentration of capital, labor, skills in Society 4.0 to their decentralization in Society 5.0),
- liberation from fears and anxieties (from the sensitivity of Humanity 4.0 to the resilience of Humanity 5.0),
- liberation from resource and environmental constraints (from the high environmental impact of mass consumption in Civilization 4.0, to the sustainable development and environmental harmony of Civilization 5.0),
- liberation from the particularism of Humanity 4.0 to the joint creation of value and its sharing by Humanity 5.0 (needs, expectations and values relevant to society as a whole).

Society 5.0 is intended to be a super-smart civilization of prosperity, in which artificial intelligence and robots do not take control of humanity but provide a partner support for it. This allows each person, leading a different lifestyle, to strive for own happiness, creating value at any place and time, in a safe and harmonious, unobtrusive environment. Generational, gender, racial, cultural, economic and political diversity doesn't lead to inequalities. Innovation is not only aimed at supporting economic development, but above all, at the ultimate resolution of social, environmental and economic problems. The focus is on solutions that resolve both global ills and focus on an individual.

4 The employee dimension of civilizational transformations

The third technological revolution brought about new industries and a complete change of existing sectors. We live in an age of man-made industries, based on the knowledge and the power of the mind, and embedded in an ubiquitous digital network. The future is a cybereconomy of smart services, and the sector is characterized by a high wage differential. As a result, the revolutions that led to higher and more evenly distributed

wages were replaced by a revolution leading to lower average wages and larger differences in their distribution.

The 1990s saw a complete retreat from the dominant position of the manual worker class and their unions. The time of knowledge workers has come, as announced by P. Drucker in 1959 in his monograph, "Landmarks of Tomorrow". Most of them are, and will be remunerated much better than blue-collar workers have ever been, and their work will offer many more opportunities for professional development. As a result, since the end of the 1990s, a knowledge society has been established, with formal education as the entry barrier to the intellectual worker class (Fig. 3).

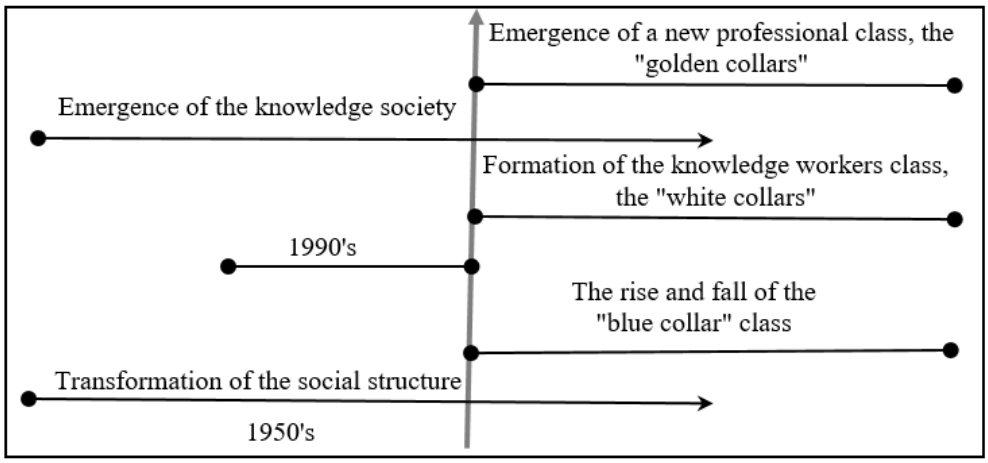

Figure 3. Evolution of societies at the turn of the 20th and 21st centuries
Source: own study based on: (Drucker, 1994; Tkach, 2019).

Due to their professional and networking skills, representatives of new professions, i.e. the "golden collar" cognitariate – individuals who can use information and communication technologies for complex cognitive operations in relation to the data (Potocki, 2019) will be a special, privileged group. Their competences, based mainly on tacit knowledge, will be specific and unique. The workers themselves will form specific, hermetic cohorts of specialists.

5 Conclusions

At the turn of the 20th and 21st centuries, economies, societies and organizations had to function according to different rules and context of the new economy - the knowledge economy.

People accumulate capital using natural resources, create social and economic organizations and catalyze the development of enterprises and entire economies (see (Kabaj, 2001; Kucznik, 2019]). The essence of the new reality is the development and rational use of human resources, because financial capital and natural resources have become passive production factors (Jacobsen, Hofman-Bang, Nordby Jr, 2005, p. 570). The basic components of the knowledge-based economy include economic process management (Szelągowski, 2019), as well as skillful management of people at all levels, which emphasizes efficiency and stimulates evolution and innovation (Skrzypek, 2013), including corporate entrepreneurship (Raziq, Rodrigues, Borini, Malik, Saeed, 2019; Jiménez-Barrionuevo, Molina, Garcia-Morales, 2019). The main characteristic of the new economy era is the investment focus on human capital and knowledge workers (Webster, Jensen, 2006, p. 82; Potocki, 2019, p. 30), and its main carriers: high-tech industry, knowledge-saturated services and education (Skrzypek, 2011, p. 270)

By giving rise to specific challenges, the first quarter of the 21st century poses specific questions regarding the further development of economic systems, forms of organization and the used dominant resources. At this stage, the final outcome of these fundamental questions can only be assumed. The knowledge society is struggling mainly with ignorance. Its key production sector is services, and the overarching resource is knowledge, which is also the foundation for the social infrastructure.

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INFORMATION MANAGENENT AND INNOVATION

Use of the TOPSIS method in ICT purchasing decisions

Blanka Bazsova[1]. Marek Stepan[2]

Abstract.
Methods of multicriteria decision-making become a part of everyday manager´s work. The paper focuses on the application of the TOPSIS method, which is based on the calculation of the distance from the ideal and basal variant. The TOPSIS method is one of the multicriteria decision-making tools, which was applied in deciding on the choice of the laptop, in this paper. Five types of the laptops from different manufacturers were evaluated according to five selected criteria. The results of this application showed that the Acer and the Dell notebook performed best in this evaluation.
Keywords: Decision-making, ICT, laptop. TOPSIS.

JEL Classification: C44, D19

1. Introduction

Information and communication technologies (ICT) have become an integral part of young people's lives. People use them practically in everyday activities - at work, at school in the educational process and in leisure activities too. We include desktops, tablets, laptops, smart-phones and the Internet in ICT resources. The digital skills that a person acquires through the use of ICT are among the competences of modern times and are essential for the development of a given country. The Czech Statistical Office carries out regular monitoring in the ICT branch. which collects and summarizes data concerning their use both in households and by individuals and companies.

Computers and the Internet have become a common part of all households in recent years. Ten years ago. 59% of households had a computer and 56% had an Internet connection. Now the share of computers is more than 80%. (CZSO. 2020). In 2020. almost four-fifths of Czech

[1] VŠB-Technical University of Ostrava/Faculty of Economics, Department of Systems Engineering, Sokolska 33, 701 00 Ostrava, blanka.bazsova@vsb.cz.
[2] VŠB-Technical University of Ostrava/Faculty of Economics, Sokolska 33, 701 00 Ostrava, marek.stepan.st@vsb.cz.

households (79%) already have a computer (including a tablet). and a similar share is also available to the Internet (82%) (CZSO, 2020).

Students especially appreciate the Internet connection from portable devices (laptops. tablets and mobile phones). Phones are already dominated by their "smart" versions - smartphones. Smartphones then clearly lead among students. In 2019. 98.2% of them connected to the Internet. more often via WiFi (96.9% of students) than via mobile data (84.5% of students). (Víchová, 2020)

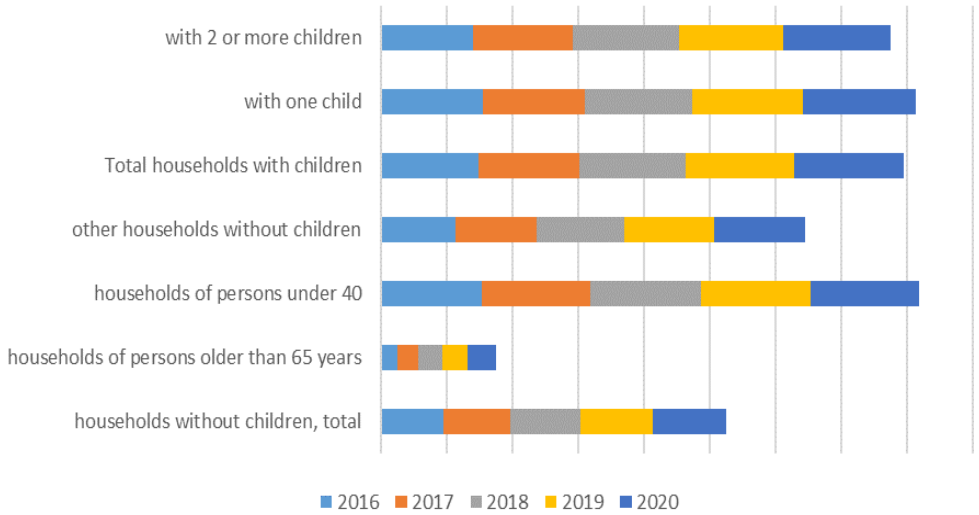

Figure 6 Share of households in the Czech Republic with a laptop expressed as a share of the total number of households. Source: CZSO. modified

As we can see at Figure 1 the share of laptops in Czech households is growing during 2016-2020. It grows in all age groups and households with one child have the highest share. ie it reaches up to 80% of the total number of these households. Households under the age of 40 also show a high share. This growing trend is most likely to continue in the coming years due to the transition of virtually all schools to distance education.

The number of students using a laptop to access the Internet has also exceeded 90%. The number of students using the Internet on a tablet lags behind a phone and a laptop. but has increased significantly since 2013. by 43 percentage points (from 5.4% to 48.4%). Graph 2: Students' use of the Internet on individual types of facilities; 2019 Source: CZSO. survey on the use of ICT in households and among individuals. (Vichova, 2019)

There are several reasons for the increased demand and purchase of ICT technology. specifically laptops. The Internet. as a source of information and a communication tool. can also be used for education. And just at the time when schools were closed and teaching moved to the online environment. we can see an increase in participation in online courses. growing communication with teachers through web portals and an increase in the number of people who use teaching materials online. The increases are evident especially in the group of students and the related age category of 16-24 years (CZSO, 2020).

The first is their easy portability. Unlike a desktop computer. it can be taken with you virtually anywhere. Laptop users prefer them because of online tuition. training in retraining and retraining courses. Another reason for buying laptops is the possibility of relaxation through games or communication within social networks. etc. Working with applications is an integral part of them needed for work or study. The most used applications are MS office applications - Word. excel and then also Powerpoint. which was confirmed in the survey of the Czech Statistical Office in 2019. In order for students to be able to fully use information technology (not only) for study purposes. it is today necessary to control at least the basic so-called office software. The CZSO survey shows that this should not be a problem for Czech students. over 90% of them stated that in the last 12 months they used Word or another text editor. or Excel or a similar spreadsheet. of which 56.7% used it. including advanced features. Almost 70% of students also created presentations in one of the designated programs. Students use office programs approximately 2 to 4 times more often than the general population (Víchová. 2020)

2. Quantitative methods and TOPSIS

Today, every manager in the company uses quantitative methods, specifically methods of multicriteria decision-making. This contribution is proof that they can also be used by an individual for his individual decisions. Quantitative methods. simply put. convert words into numbers that they interpret. Quantitative methods are applied in various fields and scientific disciplines. Quantitative methods include basic and descriptive statistics, multicriteria decision-making methods, methods, game theory, quality assessment methods, operational research methods, simulations, models of major

subsystems, including inventory management systems, queue theory models, collective service, financial methods, which include discounted cash flow and many other sub-methods. According to research conducted in 1995, basic and descriptive statistics are in the first place in the use of quantitative methods. discounted cash flow in the second place. quality management methods in the third place. and decision analysis and balancing methods in the third place. (Wisniewski. 1996) The reason for their use is the growing complexity of problems and the growing amount of information on which to make decisions. Individuals also struggle with large amounts of information pouring in from all sides. This also applies to choosing a laptop for work at home.

To determine the weights of the criteria. the method of pairwise comparison was chosen. which is one of the methods of multicriteria evaluation. The TOPSIS method was used to evaluate variants according to the criteria.

TOPSIS, abbreviation -Technique for Order Preference by Similarity to Ideal Solution. This is a method that minimizes the distance from the ideal variant and maximizes the distance from the basal variant. (Dědina, Fotr and Hrůzová, 2003) The prerequisite for the calculation itself is that all criteria must be converted to maximization criteria. This means that all minimization criteria must be adjusted based on the relation:

$$y_{ij} = -y_{ij} \,. \tag{1}$$

The TOPSIS method is based on the following steps:

1. Conversion of all criteria to maximization criteria y_ij = 〚- y〛 _ij.
2. Creating a normalized matrix R = (r_ij)
3. Creating a weighted normalized matrix Z = (z_ij)

based on relationships:

$$r_{ij} = \frac{y_{ij}}{\sqrt{\sum_{i=1}^{m} y_{ij}^2}} \tag{2}$$

where *i = 1. 2..... m ; j = 1. 2..... n*

$$z_{ij} = r_{ij} \times v_i \tag{3}$$

Where v_j is weight of j-th criteria

4. Determination of basal $D = (d1. \ldots . dn)$ and ideal (variant) choice $H\ (h1. \ldots . hn)$ based on the relation:

$d_i^+ = \sqrt{\sum_{j=1}^{n} (z_{ij} - h_j)^2}$ for basal choice (4)

$d_i^- \sqrt{\sum_{j=1}^{n} (z_{ij} - d_j)^2}$ for ideal choice (5)

5. Calculation of the distance of individual variants from the ideal variant. The distance calculation is expressed according to the relation:

$$c_i = \frac{d_i^+}{d_i^+ + d_i^-}$$

(6)

One well-known online store was chosen to choose a laptop, which offers their delivery not only including software, ie accessories, but also provides advice that is useful when buying and choosing a laptop. Based on the specification of their requirements and the reason for using the laptop either for fun or for work at school or work, a potential user can decide, which laptop to choose for their work. According to the selection and evaluation of an ICT expert, the following information was selected and further analyzed to objectify the purchase:

Students need a laptop mainly for work at home, especially for study purposes and teaching support, especially with regarding to the current development of Covid disease and its consequences, i.e. the closure of schools and the introduction of distance learning. The user especially prefers the performance and speed of the device and the possibility of installing other applications. Furthermore, students prefer the already installed Windows operating system. A longer warranty than usual (2 years) and additional insurance are not required.

3. Application

5 evaluation criteria were chosen for objective decision-making when buying a laptop: C1 – processor, C2 - diagonal length, C3 – price, C4 - memory size, K5 - weight.

The following laptop alternatives were selected (Alza, 2020):

A1 – Asus, A2 – Acer,A3 – Dell, A4 – HP, A5 -Lenovo

Verbal description of individual variants:

Option 1: Asus Zenbook 14UM425IA Pine Gray

is an all-metal ultrabook, equipped with AMD Ryzen 7 4700U processor. 14 "IPS, matte 1920 × 1080, 16GB LPDDR4X RAM. AMD Radeon Graphics, SSD 512GB, backlit keyboard, webcam, USB 3.2 Gen 2. USB-C, WiFi 6. 67 Wh battery, Weight 1.22 kg, operating system Windows 10 Home UM425IA-AM020T, price 24990. - CZK.

Option 2: Acer Travel Mate P4

Notebook - Intel Core i7 1165G7 Tiger Lake, 14 "IPS matt 1920 × 1080, RAM 16GB DDR4, Intel Iris Xe Graphics. SSD 512GB, backlit keyboard, webcam, USB 3.2 Gen 1, USB-C, fingerprint reader, WiFi 6. weight 1.3 kg, operating system Windows 10 Pro (TMP414-51-76ME), price 25 390. - CZK.

Option 3: Dell Latitude 5410

Notebook - equipped with Intel Core i7 10610U Comet Lake processor, 14 "IPS anti-glare 1920 × 1080, RAM 16GB DDR4, Intel UHD Graphics, SSD 512GB, backlit keyboard. Webcam, USB 3.2 Gen 1, USB-C. WiFi 6. 5913 mAh battery. Weight 1.52 kg, Windows 10 Pro (NBD), price 35 990,- CZK.

Option 4: HP 15s-fq1901nc Natural Silver

Notebook with Intel Core i3 1005G1 Ice Lake processor, 15.6 "VA matte 1920 × 1080, 8GB DDR4 RAM, Intel UHD Graphics, SSD 512GB. numeric keypad. backlit 1920 × 1080keyboard, webcam. USB 3.2 Gen 1. USB-C. WiFi 6 . 41 Wh battery, Weight 1.74 kg, Windows 10 Home 29A93EA, price CZK 15 990,- CZK.

Option 5: Lenovo V15-IIL Iron Gray

Notebook - Intel Core i5 1035G1 Ice Lake. 15.6 "TN antireflective 1920 × 1080, RAM 8GB DDR4, Intel UHD Graphics, SSD 256GB, webcam, WiFi 5, 35 Wh battery. Weight 1.85 kg, Windows 10 Home, price 17 990, - CZK

	Processor (GHz)	Diagonal (")	Price (CZK)	RAM (GByte)	Keyboard	Distinction (bpi)	Weight (kg)
Asus Zenbook	AMD Ryzen 7.4 GHz	14	24990	8	yes	1920 × 1080	1.22
Acer Travel Mate P4	Intel Core i7 1165G7	15.6	25390	16	yes	1920 × 1080	1.3
Dell Latitude 5410	Intel Core i7 10610U	14	35990	16	yes	1920 × 1080	1.52
HP 15s-fq1901nc Natural Silver	Intel Core i5 1035G1	15.6	15990	8	es	1920 × 1080	1.74
Lenovo V15-IIL Iron Grey	Intel Core i5 1035G1	15.6	17990	8	yes	1920 × 1080	1.85

Table 2 Summary of the basic information. (own processing)

All laptops have Windows 10 Home, a numeric keypad and a monitor resolution of 1920 × 1080 (see Table 1). Therefore. these criteria were excluded from the evaluation. Laptops differ only in diagonal length. price. memory size and weight. Therefore, these 5 criteria were considered for multi-criteria evaluation using the TOPSIS method. It is first necessary to determine the weight of the individual criteria. The weight was determined by the pairwise comparison method, which can be seen in Table 2. The criterion C1 - processor speed - gained the greatest weight. Criterion C5 - the weight of the laptop had the least weight.

	C1	C2	C3	C4	C5	Total	Adjusted Total	Wage
C1		1	1	1	1	4	5	0.5
C2	0		0	0	1	1	2	0.2
C3	0	1		0	1	2	3	0.3
C4	0	1	1		1	3	4	0.4
C5	0	0	0	0		0	1	0.1

Table 3 Pairwise comparison of criteria. (own processing)

Table 3 shows the conversion of all alternatives values according to individual criteria to maximization. The conversion to the maximization criterion was necessary for criteria C3 and C5.

	O1	O2	O3	O4	O5
C1	4	5	3	2	3
C2	14	15.6	14	15.6	15.6
C3	-3	-2	-1	-5	-4
C4	8	16	16	8	8
C5	-5	-4	-3	-2	-1

Table 4 Evaluation of the options by 5 criteria by using order method. (own calculation)

	v-				
	A1	A2	A3	A4	A5
C1	0.00694	0.01563	0.00174	0.00000	0.00174
C2	0.00000	0.00005	0.00000	0.00005	0.00005
C3	0.01000	0.02250	0.04000	0.00000	0.00250
C4	0.00000	0.00640	0.00640	0.00000	0.00000
C5	0.00000	0.00007	0.00028	0.00063	0.00111

Table 5 Calculation of the distance from basal alternative. (own calculation)

	v+				
	A1	A2	A3	A4	A5
C1	0.00174	0.00000	0.00694	0.01563	0.00694
C2	0.00005	0.00000	0.00005	0.00000	0.00000
C3	0.01000	0.00250	0.00000	0.04000	0.02250
C4	0.00640	0.00000	0.00000	0.00640	0.00640
C5	0.00111	0.00063	0.00028	0.00007	0.00000

Table 6 Calculation of the distance from ideal alternative. (own calculation)

Tables 4 and 5 express the calculation of the distance of the individual alternatives. This calculation is performed according to step 4 of the TOPSIS method.

4. Results

The Acer notebook was chosen to select ICT technology, specifically a notebook for study purposes (see table 6). This notebook has an Intel Core i7 1165G7 Tiger Lake processor. has a 14 "IPS monitor, which is matte, with a resolution of 1920 × 1080. 16GB DDR4 memory. Intel Iris Xe Graphics. SSD 512GB. The keyboard is backlit. The notebook has a built-in webcam, USB 3.2 Gen 1, USB-C. fingerprint reader. has WiFi 6, weighs 1.3 kg and includes the Windows 10 Pro operating system (TMP414-51-76ME).

Order	3	1	2	5	4
z(i)	0.532509	0.065413	0.130653	0.989185	0.86905

Table 7 Order of alternative according to the TOPSIS method. (own calculation)

5. Conclusion

The reasons for the increased demand for computer technology lead analysts to develop the possibilities of applying quantitative methods, specifically the TOPSIS method, which belongs to the group of the multicriteria decision methods. In this paper, the TOPSIS method was applied to select a laptop that students will work with as part of the transition to distance learning. This places certain specific demands on their selection. For optimal decision-making, it is important to have a set of criteria according to which the individual alternatives will be evaluated. In determining the weights of the criteria, the applicability of the pairwise comparison method was demonstrated, which also takes into account the subjective requirements of a particular user. On the other hand. objectivity was also demonstrated in the evaluation and selection of the optimal variant of the notebook. The applicability of the TOPSIS method was proved for the evaluation of variants according to the set criteria. The TOPSIS method made it possible to evaluate the usefulness of individual variants for the selection of a specific notebook and to determine the distance of other variants from the ideal and basal variant

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Introduction and Innovation of a New Sorting Line for Mixed Municipal Waste

Josef Bělica[1], Jakub Chlopecký[2, 3], Roman Danel[4]

Abstract. The introduction of new sorting lines is a process that is necessary in compliance with EU directives and the Waste Act within the Czech Republic. With the introduction of new lines for processing not only municipal processes in the city of Havířov, it also entails an extremely important evaluation of investments from a financial point of view. Within information technology, the implementation and management of information systems in this sector is essential. Proper process setup using proper IT processes leads to minimizing downtime of the entire device. As this is a waste treatment with the minimization of storage space, a suitably chosen IT tool is an important basis for proper managerial decision-making and the team associated with the return on investment.

Keywords: Sorting line, information system, investment evaluation, municipality

JEL Classification: O3

1. Introduction

The worldwide trend in waste management is to make the most of the waste generated. Efficient waste management is a fundamental environmental problem worldwide. Cities and organizations not only try to motivate citizens, employees, etc. to sort waste, but also add opportunities to sort. As landfilling will no longer be possible after 2024 to the extent known today, it is necessary to respond to legislative changes, whether at the national level, regional level and especially at the municipal level. City officials need to respond in a timely manner to ensure that they find efficient, environmentally friendly and environmentally friendly waste sorting and disposal solutions to meet legislative requirements. The question arises how to ensure compliance with the legislation and to use residual waste

[1] VŠB-Technical University of Ostrava/Faculty of Mining and Geology, Department of Economics and Control Systems, Ostrava, Czech Republic, josef.belica.st@vsb.cz
[2] MVŠO, o.p.s., Olomouc/Department of management and marketing
[3] VŠB-Technical University of Ostrava/Faculty of Mining and Geology, Department of Economics and Control Systems, Ostrava, Czech Republic, jakub.chlopecky@vsb.cz
[4] VŠB – Technical University of Ostrava/Faculty of Economics, Department of Applied Informatics, Ostrava, Czech Republic, roman.danel@vsb.cz

for the benefit of all and the environment. The current situation for the city of Havířov and its surroundings does not offer a comprehensive solution for waste management that would correspond to the future obligations of the affected cities and municipalities. Another factor given the unpreparedness would be the phenomenon in which, after 2024, citizens' payments for waste disposal would increase sharply. The paper responds to the issue of waste management for Havířov and surrounding towns and municipalities and prepares technology for the treatment of mixed municipal waste directing.

1.1 Theoretical basis of the analysis of investment efficiency evaluation

Investments are an important factor in the social and economic development of society. With the help of investments, the perspective policy of the state, individual areas and companies is implemented. They are an important connecting link between the present and the future of the investment economy, ie. positively affect supply and demand. This fact shows that investment supports the country's economic growth. The investment fulfills three functions:

- Capacity - here it is possible to include the renewal and creation of new capacities for production.
- Substitution - the efficiency of production of goods.
- Pension - creation to support demand in the economy of the state, region, etc.

Every company that is in good financial condition should consider and plan investments of funds not only in the reconstruction, but in today's turbulent world, especially in the development of the company. Investment activity is not a normal financial activity of the company, but it is an activity that is related either to maintaining the existing competitive potential of the company, which is related to the renewal of not only equipment, or its expansion by so-called development.

The criteria of investment efficiency can include, for example:

- Profitability - profitability.

- Liquidity - time.
- Riskiness.

2 Selected method of investment evaluation

The dynamic method of evaluating investments, namely the Net Present Value (NPV) of an investment, is the difference between the present value of the project's expected cash flows and all the project's investment costs. This is one of the most accurate and reliable methods of evaluating investments. It can also be defined as the sum of the discounted net cash flow of a project over its useful life, including both periods construction, as well as the period of operation of the investment. The net present value can be expressed mathematically by the following expression:

$$NPV = PVFC - IN = \sum_{t=1}^{n} \frac{Cf_t}{(1+i)^t} - IN \quad (1)$$

NPV	Net Present Value
PVCF	Present value of cash flow
CFt	Cash flows in individual years
IN	Investment costs for the project
i	Discount rate (capital costs for an investment project)
t	Period 1 – n
n	Life of the investment (project)

3 Description of new technology

For efficient processing of municipal waste into usable products, a processing line consisting of partial equipment is used, which ensures the implementation of individual technological steps. The aim of the whole process is to sort waste into individual products, which after mechanical treatment by pressing or crushing will be shipped to other specialized processing facilities such as recycling lines, composting plants or energy sources.

The entire line is in a closed vacuum hall, from which the air is extracted and then cleaned using biofilters. The aim is to prevent possible pollution of the environment by odor emissions. The scale model of the line is shown in Figure 1.

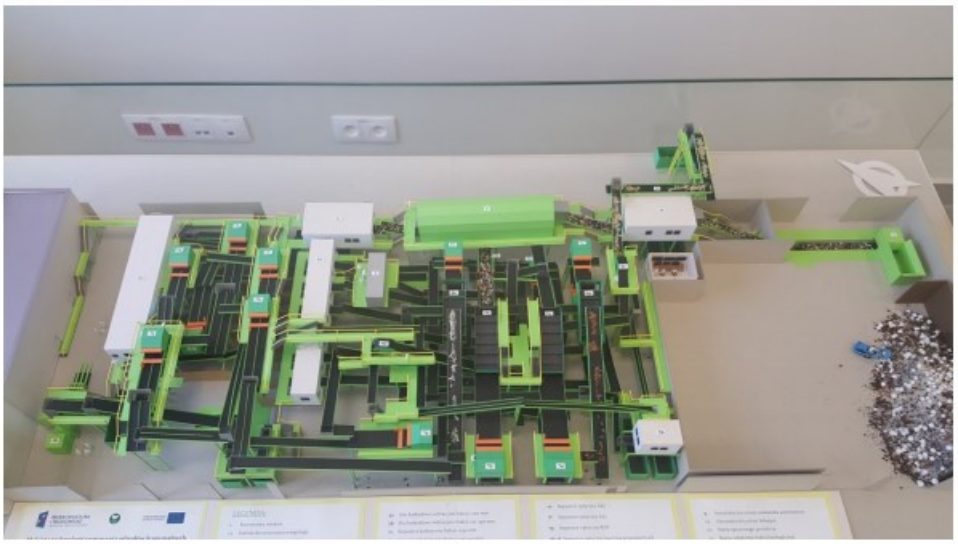

Figure 7 Municipal waste treatment line model. Source: own.

The treatment of each waste entails certain costs. Some waste commodities are not yet profitable to process, respectively. there is no use for them in secondary processing. These are mainly output raw materials: waste fraction from 0-50 mm (which represents approximately 40 % of waste), solid alternative fuel (TAP) and unusable waste. This waste will be landfilled or otherwise processed (TAP), so it is a cost that the company must incur to process this waste. The processing of other waste commodities entails revenues that are already adjusted for the costs of processing from mixed municipal waste. These are waste items: paper, cardboard, polyethylene terephthalate (PET) film, high density polyethylene (PEHD), plastics (PP), beverage cartons, iron, aluminum, and others.

4 Evaluation of return on investment

It is a type of waste that can be sold in the market environment as a secondary raw material and it is possible to obtain revenues from it, resp. funds. Investment financing of the project is considered from own resources and from the resources of the European Union or national resources.

A comparison table of all four financing and profitability options is given in Table 1. The data are for the first year of operation, because at that time no additional input variables are known for many to appreciate the return on investment in the longer term.

Table 8 Four variants of financing and profitability in an abbreviated comparative comparison. Source: own calculations

Investment variant	***Total revenues***	***Total costs***	***Profit***
Variant 1.A: 75 000 t, 0 % grant, profit 5 %	103 610 000	98 375 000	5 235 000
Variant 1.B: 75 000 t, 60 % grant, profit 5 %	85 865 000	81 575 000	4 290 000
Variant 2.A: 75 000 t, 0 % grant, profit 10 %	109 330 000	98 375 000	10 955 000
Variant 2.B: 75 000 t, 60 % grant, profit 10 %	*90 675 000*	*81 575 000*	*9 100 000*

The income for all variant solutions is mainly from the statutory fees for waste treatment for the citizens of the city. In total, the revenues for this considered variant are 103,610,000 CZK. Waste treatment costs, personnel costs, depreciation, etc. are considered in the amount of CZK 98,375,000. Profit before tax is CZK 5,235,000.

Option 1.B envisages a subsidy of 60% and a profit of 5%. The theoretical annual capacity for the treatment of mixed municipal waste is 75,000 t with a revenue of CZK 1,321 per tonne of mixed municipal waste. Revenues from municipal waste treatment in this variant are considered in the amount of CZK 85,865,000 per year. The total costs (for processing, depreciation, fixed and variable) are calculated in the sum of CZK 81,575,000 per year. Profit before tax is CZK 4,290,000 / year.

A variant solution of the investment project 2.A is for the processing of the same amount of waste, ie a theoretical value of 75,000 t / year. Revenues in this variant should reach CZK 109,330,000 and the total costs are estimated at CZK 98,375,000. Profit before tax should reach CZK 10,955,000. The last variant of the investment project for a facility

for the treatment of mixed municipal waste is variant 2.B. In this variant, a 60% subsidy and a 10% profit are considered. The theoretical volume of mixed municipal waste treatment is 75,000 t / year. Revenues from waste treatment should amount to CZK 90,675,000 per year. The total costs should account for CZK 81,575,000 per year. Profit before tax for the year should be higher CZK 9,100,000.

5 Conclusion

The evaluation of investments within the public sector, resp. manages the management of public funds differently than in the business sector. The investment primarily responds to legislative requirements. Achieving the highest possible profit or the highest possible market value in municipal companies is not the main priority. In this case, the basic income is the legal fees of the population in connection with the treatment of waste. The amount of fees is determined by each self-governing entity at its own expense and focusing on the amount of profit would have a very negative impact on the inhabitants of the affected or affected municipalities. This topic is "sensitive", especially from a human and political point of view. The presented article summarized the evaluation of the investment in the first year of operation of the sorting line. Further evaluation of the investment, especially in the longer term up to the end of the life of the line, will be the subject of further research.

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Innovative challenges for CRM

Viktorie Dombrovska[1] Josef Durczok [2],
Tereza Ikasova [3], Tomas Sedlacek, [4]
and Milena Janakova [5]

Abstract. CRM (Customer Relationship Management) systems have a stable role in IT (Information Technology) supporting customer relationships. There are default activities that take care of contact information, marketing, segmentation, leads, or sales in an IT market with great potential for innovations. The development of information technology is rapid and the same rate of change is evident in the needs of customers and their care. This is a lot of competition and also about increasing user requirements. In this paper, the literature review focuses on innovative challenges for CRM that are implemented quickly. These include chatbot and third-party software (such as Google Apps) integration, or links on IoT (Internet of Things). The selection was based the need to increase better communication with customers, easy work with CRM and thinking about attractive and new ideas for business in the future.

Keywords: CRM, chatbot, Google Apps, information technology, innovations, IoT

JEL Classification: D8; C8; M3

1 Introduction

Innovations bring changes in the implemented processes to improve business activities. During a pandemic, it is necessary to make changes in all business activities. There are limitations, and one way to continue doing business has been to use information technology (IT) through innovation to optimize performance (Agarski, B. et al., 2019). There are not only major changes that are unique on a global scale, but also small innovations at the business level for individuals, enterprises, localities, or at the level of regions and states. Innovations based on information technology have been useful for continuing business activities, developing customer opportunities (Bonney, L. et al.,

[1] Silesian University in Opava, SBA in Karvina, Univerzitni namesti 1934/3, 733 40 Karvina, Czech Republic, e-mail O190276@opf.slu.cz.
[2] Silesian University in Opava, SBA in Karvina, e-mail O190277@opf.slu.cz.
[3] Silesian University in Opava, SBA in Karvina, e-mail O190278@opf.slu.cz.
[4] Silesian University in Opava, SBA in Karvina, e-mail O190279@opf.slu.cz.
[5] Silesian University in Opava, SBA in Karvina, e-mail mija@opf.slu.cz.

2020), and offering goods and services through e-shops. Many services and activities were moved to virtual space and access was online. The issue for this paper is innovations for CRM (Customer Relationship Management) that support online communication via chatbot, level of integration of familiar Google applications, or ideas for using the Internet of Things (IoT).

2 The Necessity of CRM

The necessity of CRM is visible in all activities to support business development. CRM is a large industry with the necessary rules and methods of customer care. The starting point of CRM is defined in 1980, when Robert D. Bob and Kate Kestnbaum laid the groundwork of database marketing (History of CRM Software, 2020). Since then, it is a long time to develop CRM into a sophisticated area with a very important place in business. Market trends and statistics (Gheorghiu, G., 2019, Liu. S., 2020) show in many numbers:

- Sales of the CRM software market were approximately $42,707 million in 2019 and are estimated to reach approximately $42,878 million in 2020, and $43,049 million in 2021.
- Importance of SaaS (Software-as-a-Service) for CRM implementation with the ability to engage CRM market is estimated at 75%.
- There is a growing interest in tools (such as Outlook 29%, Excel 22%, Gmail 14%, and Office 2%) that use customer databases to work with them when making a purchase support.
- Important technical requirements for CRM, such as automation 45%, integration 36%, mobile support 20%, or easier to use 15%.
- Essential CRM features such as contact marketing 50%, sales management 33%, lead and opportunities 33%, and reporting and analytics 32%, or marketing automation 30%.

There is a great variety and variability of the offered software on the CRM market, from simple tools to sophisticated solutions. Well known leading CRM vendors are Adobe, Microsoft, Oracle, Salesforce, and SAP. They have more than 40% of CRM software market. There are rich solutions and their maintenance requires optimal resources (technology, human resources, and also material background). From a small business

perspective, it is more of a user-friendly IT implementation with the potential for innovations in data analytics (Hallikainen, H. et al., 2020; Lam, H. Y. et al., 2020), social network integration (Harrigan, P. et al., 2020), the use of artificial intelligence (Libai, B. et al., 2020). The reason is to look for easier ways to improve contact with customers. Through chatbot online communication it is meant to be more social and mobile friendly. Another option is to take advantage of the integration of third party software that is well known, such as Google applications. Last but not last, many IT users perceive amazing opportunities in IoT's ideas to develop new applications.

3 Challenges for Innovation

The challenge for innovation is to stay in touch with customers. One way is to properly implement information technology, such as chatbot to support optimal communication with customers. Benefits include automation, standardization, and user-friendly answers to customers. There are solutions like AgentBot, Amy Ingram, Bold360, ManyChat, or OMQ chatbot (Kumar. V., 2020). Implemented artificial intelligence is responsible for this automated communication with customers, because there is a defined knowledge base for defined events. A chatbot may be created without programming to use chatbot software (Instabot, 2020). It is also possible to use Facebook Messenger or create a chatbot in Java, Python, or also in C#. The advantage is the integration of chatbots with email systems, social networks, and information systems such as CRM.

Another way is to help communicate with customers is to focus on integration third party software into CRM, such as Google applications. Google (Google Workspace, 2020) offers a large number of well known applications, such as Google Calendar, Google Drive, Google Keep, Gmail, and Google Sheets. The advantage is that they are well known and easy to work with them. CRM systems such as Agile CRM, SugarCRM, Zoho CRM offer this integration into their solution. Perhaps the biggest interest is in integrating Gmail (14 Best Gmail CRMs 2021, 2020) and Google calendar (CRM Apps Integrated with Google Calendar, 2020) into CRM. The requirements focus on the organization of the Gmail dashboard, email templates, synchronization, and the ability to track communication across different channels. For Google calendar, it is about adding events logs

as contacts to CRM to continue communicating, sharing saved meeting logs, and reducing unnecessary tasks.

The big challenge is to think about IoT. The advantages are related to the increasing degree of personalization, the effectiveness of the marketing process, the ability to change prices, and the necessary customer satisfaction (Jordan, R., 2019). A visible advantage is the ability of the IoT device to collect data that is automatically sent to other systems for processing. It is a great stimulus for new income for businesses. For CRM, these are data with a suitable context, which are presented and processed for future opportunities based on customer behavior, location, and needs in CRM areas such as marketing, sales, and services (Rizvi, M., 2017).

The above literature review of the innovations focuses on the integration of chatbots, Google Apps and IoT into CRM. The discussion is about the potential to improve the necessary areas of CRM, which are in the approach of many analyzes, such as:

- The impact of CRM strategy on the relationships to the effects of learning from failure (Nguyen, B. et al., 2020).
- Use of artificial intelligence to analyze the consumer behavior (Serova, E., 2019).
- The impact of CRM technology on sales (Rodriguez, M. et al., 2018).
- The effect of CRM for new product development (Nazari-Shirkouhi, S. et al., 2015).

Another challenge is how in many cases business will resume activities (Spiliopoulos, 2020) with employees and customers working from home. The first examples are here. For example, to start a business that has several hundred people in one location and a time, you need to ensure that Covid-19 infection is minimized. To this end, this is achieved by implementing smart belts that monitor where the employee is located. If it is too close to another employee, the belt will vibrate. Another solution is to see a smart thermometer in the helmet that will be able to measure temperature remotely.

4 Conclusion

This paper focuses on innovative challenges for CRM. Nowadays, it is essential to restart business and communication with customers. There are also smaller steps that will help in business. A good example

of the literature review is integration of chatbot and third-party software, which may be implemented with minimal resources and skill and time requirements. The idea of IoT about new applications and services for customers and businesses also brings a good advantage for increasing impact on CRM strategy, technology and analysis.

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Technologies Accelerating the Transition to a Low Carbon Economy in the Energy Industry in the Moravian-Silesian Region

Filip Kempa[1]

Abstract. The conversion of energy into low-carbon sources is an important measure to slow down climate change. The article will focus on the transition to a low-carbon economy in industrial production and on the possibilities of using information technologies in this area. The possibilities of using information technologies of the low-carbon economy will be interpreted in general for the whole Czech Republic, a substantial part of the article will be specifically focused on the issue of low-carbon economy in the Moravian-Silesian region. The Moravian-Silesian region is historically connected with the mining industry, especially with the mining of hard coal, which has been gradually suppressed in recent years. Globally, the transition to a low-carbon economy should provide significant benefits, in terms of creating new jobs, sustainable growth and, above all, reducing carbon dioxide production.

Keywords: climate change, low carbon economy, energy, greenhouse gases, emission, carbon dioxide

JEL Classification: Q01, Q53, Q56

1 Introduction

The gradual transition to low-carbon energy sources and the associated climate change are one of the most pressing challenges of this century worldwide. The main essence of the transition to a low-carbon economy is to reduce greenhouse gas emissions, which are the reason for the deteriorating air quality. Poor air quality in the Czech Republic is caused by industry, road transport, building heating and agriculture. Not only in the world, but also in the Czech Republic, many measures have already been adopted and subsequently approved for the development of a low-carbon economy, but much remains to be done on this issue. It is also necessary to mention the fact that air quality in the Czech Republic is one of the worst than in other countries of the European Union. Reducing carbon dioxide and other

[1] Ing. Filip Kempa, VŠB - Technical University of Ostrava, Faculty of Mining and Geology, Department of Economics and Control Systems, 17. listopadu 2172/15, 708 00 Ostrava, Czech Republic, filip.kempa@vsb.cz .

greenhouse gas emissions is very important due to the need to slow down global warming.

Cohesion policy plays an important role in supporting the European Union's transition to a low-carbon economy, in line with the Energy Union's strategy. For the period 2014-2020, the rules of the European Regional Development Fund (ERDF) stipulated that for the first time, Member States were obliged to allocate a minimum part of the available funds to the low-carbon economy:

- 20 % of national ERDF resources in more developed regions
- 15 % transition regions
- 12 % in less developed regions (ec.europa.eu, 2014)

Member States significantly exceed these minimum shares and EUR 40 billion from the ERDF and the Cohesion Fund is now set aside for investment in a low-carbon economy for the period 2014-2020. (ec.europa.eu, 2014)

The article focuses on the issue of the transition to a low-carbon economy and the use of information technology in this field in the Czech Republic. A substantial part of the text of this matter is devoted to the Moravian-Silesian region, with which, as is well known, industrial production and mining is historically connected. It is mainly the extraction of hard coal. The extraction of this very raw material in this region has had a negative effect not only on air quality, but also in other areas, such as mined soil, which has caused buildings to sink and crack.

2 Climate change

In the last century, climate change has become increasingly evident in global warming. There are two ways to resist global warming. The first is adaptation to transformation, so-called adaptation, and the second is mitigation of global warming, so-called mitigation. There is a third option, doing nothing, which is the most convenient and cheapest option, but in the long run would lead to decimation of the landscape, a reduction in the quality of all ecosystem services, which would further reduce economic performance through individual sectors.

Mitigation is meant as prevention in the sense of mitigating or slowing down climate change. Reduction of greenhouse gas emissions or energy savings or the production of green energy is most often associated with mitigation. An example of mitigation measures is technological change or substitution, which reduces resource inputs and emissions, as well as increasing the percentage of forests and storing carbon dioxide in biomass. It is impossible to remove excess greenhouse gases from the atmosphere and stop ongoing changes through mitigation. Therefore, it is necessary to create adaptation strategies. (klimatickazmena.cz, 2016)

In principle, any modification that reduces vulnerability to the effects of climate change can be considered as an adaptation measure. This is an activity across sectors from the breeding of new drought-resistant varieties in agriculture, through the application of anti-erosion or water management-oriented land improvements in our landscape, or the purchase of snow cannons in the winter recreational business. Adapting to climate change is a societal challenge that must involve primary production, scientists, public administrations, the education sector and politicians. Together, conditions must be created for effective adaptation measures based on careful planning. What is important is to realize that the bearer and implementer of adaptation measures must be individual companies (agricultural, forestry, river basins, etc.). (klimatickazmena.cz, 2016)

In general, however, both ways are needed to reduce the effects of climate change. Likewise, strategies for mitigating and adapting to climate change need to be developed from the individual level, through local, national and global efforts. (klimatickazmena.cz, 2016)

Among the first European measures will be a draft standard committing the Union to climate neutrality or the creation of a fund to support regions dependent on fossil fuel energy. The Czech Republic is one of the countries that could draw on it. In the Czech Republic, these would be regions formerly dependent on coal mining, specifically the regions of Karlovy Vary, Moravia-Silesia and Usti nad Labem. (ČTK, 2019)

3 Technologies of low-carbon economy in the Czech Republic

To implement a low-carbon economy, there will be a need to significantly expand zero or low carbon technologies. These include nuclear energy, natural gas, renewable energy technologies and carbon capture and storage (CCS) technologies. On the same principle as energy is generated in our Sun, nuclear energy is created. (Ševčík and Duchková, 2019)

Key technology areas that will play a critical role in view of the growing need for electricity:

- Reliable electricity supply is necessary due to the growing dependence of economies on digital technologies.
- Special advanced management tools should enable more efficient delivery depending on requirements (network load) that change over time.
- Advanced information systems should be able to create dynamic pricing in near real time, allowing customers to influence their costs.
- Data on user requirements as well as dynamically changing energy prices should enable the development of new business models as well as increased competition in a changing market.
- However, there are also a number of obstacles to realizing the vision of smart grids, insufficient information on the part of consumers, privacy and security throughout the chain and the absence of widely accepted standards.
- Experts generally assume that the rapid entry of electric cars will also have a significant impact on the development of smart grids, as they will support investment in infrastructure, the emergence of new services and consumer awareness of their energy needs. (itreport.cz, 2012)

"Smart grids will be key to achieving energy efficiency goals, enabling optimal use of both conventional and renewable energy sources," said Bastian Fischer, vice president of industrial strategy for Oracle Utilities. "Despite promising progress, we still have a lot of work to do by 2050. In particular, customers' trust and their willingness to share in the vision of smart energy will need to ensure the protection of their privacy. " (itreport.cz, 2012)

For the transition to a carbon-free economy, it is necessary for the state to stop subsidizing fossil fuels and start divesting (shifting its finances from companies and enterprises engaged in the extraction of fossil fuels). (Ellis, Baker and Lemma, 2009)

Among the means to speed up the transition are:

- Financing in developing countries
- Dissemination of technologies
- Human capital development
- Dissemination and financial support of low-carbon resources
- Imposition of carbon taxes and carbon markets

The imposition of carbon taxes on the generation of carbon dioxide emissions and other environmentally harmful activities has not yet been used effectively in the Czech Republic. As Figure 1 below shows us, the share of environmental taxes in gross domestic product (GDP) in the Czech Republic is one of the lowest in the European Union. The other means mentioned above will not be discussed in detail due to the brevity of the article.

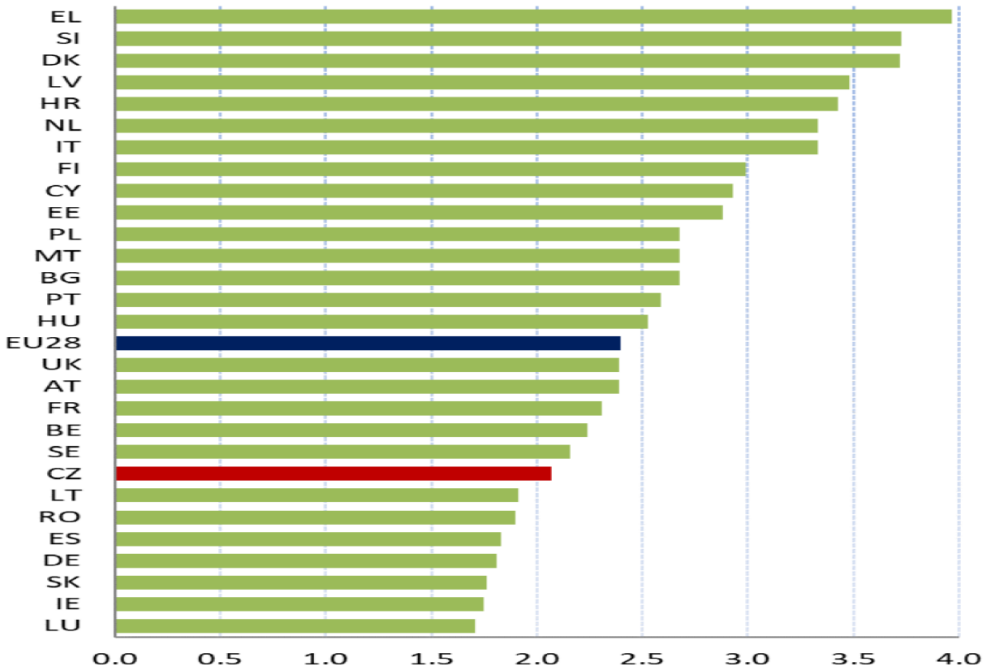

Figure 8 Environmental tax revenues as % of GDP in 2017, Source: Eurostat, 2019.

The Czech tax structure is characterized by a high percentage of income from labor taxation in the country's total income. Increasing the taxation of environmentally harmful activities could reduce the taxation of income from work. However, this is not a tax reduction for all employees, because such a reduction would be imperceptible to them. Consideration should be given to expanding the range of solutions (eg tax deduction) for decision-makers, eg to build small installations producing energy from renewable sources (photovoltaics, biomass, wind energy). (Koryś et al, 2019)

To develop a low-carbon economy in the Czech Republic, it will be necessary to increase financial challenges for the introduction of technological activities that are guaranteed to reduce greenhouse gas emissions. All these co-financing activities should apply not only to firms and companies, but also to households.

4 Technology of low-carbon economy in the Moravian-Silesian region

Climate change and environmental degradation pose an existential threat to Europe and the world. To meet these challenges, Europe needs a new growth strategy that transforms the Union into a modern, competitive, resource-efficient economy where:

- no net greenhouse gas emissions will be produced by 2050
- economic growth will be decoupled from resource use
- no individual or region will be left out (ec.europa.eu, 2017)

The Czech Republic has also joined this commitment, ie. by 2050, our state will also be climate-neutral. A joint initiative of seven large industrial companies operating in the Moravian-Silesian Region is to help the smooth transition to a low-carbon economy in the Moravian-Silesian Region. The initiative was signed by representatives of Al Invest Břidličná, Bonatrans Group, Brose CZ, Liberty Ostrava, Ostroj, Třinecké železárny - Moravia Steel and Vítkovice Steel in July 2020.

The above-mentioned companies together employ more than 25,000 people and generate an annual turnover of more than 116 billion crowns. (Vrba, 2020) Through joint proposals and projects to reduce emissions, low-carbon innovation and the circular economy, they want to contribute to a more resilient, technologically advanced region and support employment.

The initiative follows the conclusions of the Paris Agreement and the objectives of the so-called Green Agreement for Europe, approved by the European Commission. At the same time, they want to address the impact on the economy caused by the COVID-19 pandemic, and quickly start and restore the economy. These companies are ready for a gradual reduction in greenhouse gas emissions. Although the transformation of these businesses will be challenging and costly, companies see this as the right way to ensure a sustainable low-carbon economy. (msk.cz, 2020)

The Moravian-Silesian Region is one of the 41 European regions whose economy is most dependent on coal and fossil fuels. The region is part of the so-called Platform for Coal Regions in Transformation, approved by the European Commission in 2017. (msk.cz, 2020) The Coal Commission, which is an advisory body to the government, decided on the end date of coal use in the Czech Republic, recommended 2038 to the government.

A special commission of the Moravian-Silesian Energy Center prepared an impact study on whether and when the Moravian-Silesian Region could be without burning coal for heating, without the population in the winter without thermal energy in houses and flats. The Commission has found that this can not be achieved until 2030 at the earliest. Due to the huge calorific value of hard coal, it is difficult to replace. Because there is no heat source, there are three ways to replace coal: electricity, nuclear or gas. Electricity cannot be used due to insufficient distribution, the core cannot be used either, because the first small reactors that will be able to heat will be available around 2042. So there is gas left, ie. heating plants will be gradually gasified, but it will take a lot of time to stretch the gas pipes. From the available data, the Třebovická power plant will be the last to be connected to gas, in 2029. (polar.cz, 2020)

5 Conclusion

This article briefly informs about the global issue of climate change, the associated transition to low-carbon energy sources and the possibilities of using information technology in a low-carbon economy. The main essence of the article was devoted to technologies that will help accelerate the transition to low-carbon energy sources in the Czech Republic, and thus reduce the production of greenhouse gases released into the atmosphere. Specifically, the paper focused on this issue in the Moravian-Silesian region.

In the future, it will also be interesting to see whether these plans can be implemented within the proposed deadlines, and whether in 2050 not only the Czech Republic but the entire European Union will be carbon neutral.

This paper will further serve as material for a more detailed examination of the area, because the author of the article intends to continue his dissertation in this direction.

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Comparison of the Predictive Accuracy of Statistical B-J and SVM Models Applied to the Inflation Data

Dušan Marček[1]

Abstract. In Support Vector Machines (SVM´s) a nonlinear model is estimated based on solving a Quadratic Programming (QP) problem. We investigate the quantifying of economic structural parameters of inflation in Slovak Republic economics. The theory of classical Philips curve s used to specify a structural model of inflation. We provide the fit of the model based on co-integration and EC approach and use it as a tool to compare its approximation characteristics with those obtained using SVMs method.

Keywords: Time series models, SVR, ECM, co-integration, learning algorithms, kernel function.

JEL Classification: C13, G32.

1 Introduction

Model specification and estimation are two major components in econometric model building. They are often treated as two separate but closely related steps in econometric model building. In modelling economic quantities probably the most important step consists of identifying the relevant influential factors.

This contribution considers the econometric modelling of inflation process in Slovak Republic. The main tools techniques and concepts involved in econometric modelling of inflation are based on Phillip´s concept (Phillipps, 1958). In any case, the analyzed inflation rates are explained by the behavior of another variable or a set of variables in our case by unemployment and aggregate wages (Brockwell, 2016). The relationship among these variables may be complicated. Another problem is one to choose the right estimator of the model parameters. Usually the Engle and Granger two-step estimator is used for models involving all variable. In this paper the resulting SVM´s are applied using an ε-insensitive loss function developed by Vapnik (1998). In Marcek (2016) SVM method was applied for

[1] VŠB-TU Ostrava, department of applied informatics, Sokolská 33, 702 00 Ostrava, Czech Republic, e-mail: dusan.marcek@vsb.cz

half-hourly 1-step-ahead electricity demand prediction using Australian electricity data, where Support Vector Regression as prediction algorithms, outperform the statistical methods such as ARIMA (Box et al, 2013) models and neural network approaches. Jamimi (2011) has developed two different high-performance fault prediction models based on Support Vector Machines (SVMs) and Probabilistic Neural Networks (PNNs). We motivate the approach by seeking functions which approximate mapping from an input domain to the real numbers based on small subset of training sets.

The paper is organized as follows. The next section will theoretically provide the concept of SVM´s theory. Section 3 analyses the data and discuses structural (econometric) model and presents the fitted inflation rate values using the classical regression method. Section 4 describes design and application results of SVR (Support Vector Regression) estimator by the ε-insensitive loss function. Section 5 present empirical comparison and briefly concludes.

2 Support Vector Regression

This section present quickly a relative type learning machine - the SVM applied in regression (functional approximation) – SVR, that is SVMs applied to regression problems by the Vapnik´s function that enables a sparse set of support vectors to be obtained (Drucker et al. 1997; Vapnik, Gollowich, and Smola 1997). Next, we give a brief introduction to the theory and methods of SVM´s for non-linear function estimation

The learning machine is given by n training data, from which it attempts to learn the input-output relationship $y = f(x)$ where $D = \{ [x_i, y_i] \in \Re^p \times \Re, i = 1,2,...,n\}$ consists of n pairs $D = \{ x_i, y_i \}_{i=1}^{n}$. The SVM considers approximation function of two forms

$$f(\mathbf{x}, \mathbf{w}, b) = \begin{cases} \sum_{i=1}^{n} w_i \mathbf{x} + b & \text{for linear regression,} \\ K(\mathbf{x}_i, \mathbf{x}_j)\mathbf{w} + b & \text{for non-linear regression,} \end{cases} \quad (1)$$

where $K(\mathbf{x}_i, \mathbf{x}_j)$ are the so called kernel functions, w are the weights (parameters) and b represent the bias.

The optimal linear regression function is given by the minimum of the functional,

$$\Phi(w,\xi) = \frac{1}{2}\|w\|^2 + C\sum_i(\xi_i^- + \xi_i^+), \tag{2}$$

where C is a pre-specified value, and ξ^-, ξ^+ are slack variables representing upper and lower constrains on the output of the system.

Using an ε-insensitive loss function (see Figure 1c)

$$|y - f(\mathbf{x},\mathbf{w})|_\varepsilon = \begin{cases} 0 & \text{if } |y - f(\mathbf{x},\mathbf{w})| \le \varepsilon, \\ |y - f(\mathbf{x},\mathbf{w})| - \varepsilon & \text{othewise,} \end{cases} \tag{3}$$

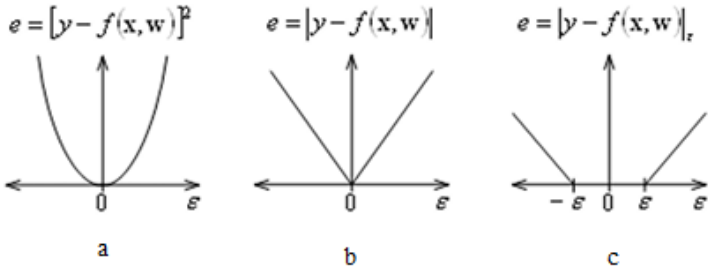

Figure 1 Loss functions.

the solution is given by

$$\max_{\alpha,\alpha_i^*} \mathrm{W}(\alpha,\alpha_i^*) = \max_{\alpha,\alpha_i^*} -\frac{1}{2}\sum_{i,j=1}^{n}(\alpha_i - \alpha_i^*)(\alpha_j - \alpha_j^*)\mathbf{x}_i^T\mathbf{x}_j - \varepsilon\sum_{i=1}^{n}(\alpha_i + \alpha_i^*) + \sum_{i=1}^{n} y_i(\alpha_i - \alpha_i^*) \tag{4}$$

with constrains,

$$\begin{aligned} &0 \le \alpha_i, \alpha_i^* \le C, \quad i = 1....,l \\ &\sum_{i=1}^{l}(\alpha_i - \alpha_i^*) = 0. \end{aligned} \tag{5}$$

Solving Equation (4) with constrains (5) determines the Lagrange multipliers α_i, α_i^*, and the regression function is given by Equation (1), where

$$\begin{aligned} \mathbf{w} &= \sum_{i=1}^{n}(\alpha_i - \alpha_i^*)\mathbf{x}_i \\ b &= -\frac{1}{2}\left[\mathbf{w},(\mathbf{x}_r + \mathbf{x}_s)\right] \end{aligned} \tag{6}$$

The Karush-Kuhn-Trucker (KKT) conditions that are satisfied by the solution are,

$$\boldsymbol{\alpha}_i \boldsymbol{\alpha}_i^* = 0, \quad i = 1,...,l. \tag{7}$$

Therefore the support vectors are points where exactly one of the Lagrange multipliers is greater than zero.

In the case of a non-linear model is usually required to adequately model data. The non-linear SVR solution, using an ε-insensitive loss function, is given by,

$$f(\mathbf{x},\mathbf{w},b) = K(\mathbf{x}_i,\mathbf{x}_j)\mathbf{w} + b, \tag{8}$$

$$f(\mathbf{x},\alpha,b) = \sum_{i=1}^{n}(\alpha_i - \alpha_i^*)K(\mathbf{x}_i,\mathbf{x}_j) + b, \tag{9}$$

where

$$\begin{cases} b = y_k - \sum_{i=1}^{n}(\alpha_i - \alpha_i^*)K(\mathbf{x}_i,\mathbf{x}_k) - \varepsilon & \text{for } \alpha_k \in (0,C), \\ b = y_k - \sum_{i=1}^{n}(\alpha_i - \alpha_i^*)K(\mathbf{x}_i,\mathbf{x}_k) + \varepsilon & \text{for } \alpha_k^* \in (0,C). \end{cases} \tag{10}$$

3 Causal Models

The objective of this section is the use of SV regression presented in previous section in estimating no-stationary economic time series which may be linked by equilibrium relationships.

To study the modelling problem of inflation quantitatively the quarterly data from 1993Q1 to 2003Q4 was collected concerning of the consumption price index *CPI*, aggregate wages *W* and unemployment *U*. These valued were measured in logarithm, among others for the reason that original data exhibit considerable inequalities of the variance over time, and the log transformation

Experimenting with linear transfer function models (Marcek, 2013), the resulting reasonable model formulation was found

$$\hat{CPI}_t = 0.5941 - 0.0295W_{t-1} - 0.00359U_{t-1} + 0.849524CPI_{t-1} \qquad (11)$$

$$(0.229) \qquad (0.339) \qquad (0.104)$$

$$R^2 = 0.7762; \quad F(3, 40) = 45.089; \quad d = 1.49; \quad d_L = 1.38; \quad d_U = 1.67$$

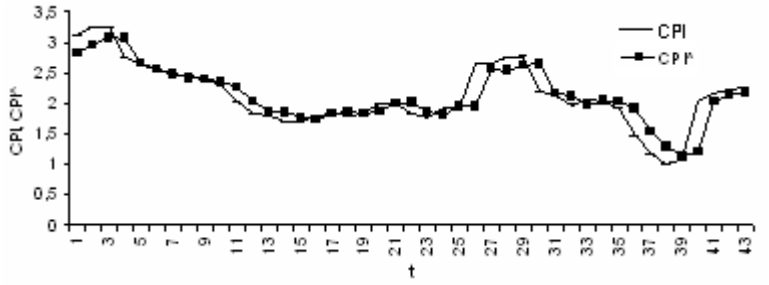

Figure 2 Natural logarithm of quarterly actual and fitted inflation values from January 1993 to December 2003 (model (11).

The model specification of (11) is the lagged dependent variable model in which the dependent variables lagged one period appear as independent explanatory variables. This model is based on a distributed lag model (Pindyck, 1991). One of the primary reason for using this functional form is to determine the long-run response of dependent variable to change in each of the independent variables. The d statistic for model (11) is 1.49 falling in the inconclusive region, making the decision concerning first-order auto-regression indeterminate. In this particular case, a decision has to be made whether or not to correct autocorrelation. In model (11), the regression coefficients for W_{t-1} and U_{t-1} have not the appropriate magnitude. In addition, they are statistically insignificant at five percent level. In all probability the lagged dependent variable CPI_{t-1} substitutes for the inclusion of other lagged independent variables (W_{t-1}, U_{t-1}). The inclusion of CPI_{t-1} and W_{t-1}, U_{t-1} is redundant and over-specified the model. A graph of the historical and fitted values for inflation is presented in Figure 2. The model follows the pattern of the actual very closely.

4 Experimenting with Non-linear SV Regression

Finally another attempt was made supposing a more sophisticated dependence of current inflation on previous observation performed by the help of SVR. As stated in literature, we can have not a model in which the coefficients are statistically insignificant. We made an arbitrary decision which delete "insignificant" variables. Then equation (10) becomes the first-order autoregressive process because the observation of CPI at time t depends only on the observation of CPI at time t - 1, i.e.

$$\hat{CPI}_t = \beta_0 + \beta_1 CPI_{t-1}, \tag{12}$$

where β_0, β_1 are unknown parameters. Since this pattern of change is common in practice, we desire that our machine identity permanent changes and adjust the parameters to track the new process.

One crucial design choice is deciding on a kernel. Creating gut kernels often requires lateral thinking: many measures of similarity between inputs have been developed in different contexts, and understanding which of them can provide good kernels depends on insight into the application domain. Table 1 shows SWM learning results by using various kernels, standard deviations in RBF kernel functions (σ), degree of polynomial functions (d). Table 1 presents also the results on trying to find the proper model by using the quantity R^2 (the coefficient of determination) on our application of the best approximation of inflation rate. Since the estimation method for SVR models is without any sound statistical theory behind it, the values of R^2 are basically intuitive, there are no "statistical correct" coefficient of determination for SVR models. As shown in Table 1 the best R^2 is 0.9711 with the exponential RBF kernel and standard deviations $\sigma = 1$. The result of all SVR models were obtained using ε-insensitive loss function = 0.2 and the degrees of capacity k.

Table 1 SVR results of four different kernel choises.

MODEL	KERNEL	σ	DEGREE-d	LOSS -FUNCTION	R^2
causal	exponential RBF	1		ε-insensitive	0.9711
causal	RBF	1		ε-insensitive	0.8525
causal	RBF	0.52		ε-insensitive	0.9011
causal	polynomial		2	ε-insensitive	0.7806

5 Empirical Comparison and Conclusion

In this paper, we examined the SVM approach to study linear ad non-linear models on a time series of inflation in the Slovak Republic. For the sake of approximation ability we evaluated six models. Five models are based on SVM methodology, one model is based on causal multiple regression. Using the disposable data a very appropriate econometric model is the regression in which the lagged dependent variable CPI_{t-1} can substitute for the inclusion of other lagged independent variables W_{t-1}, U_{t-1}. The benchmarking was performed between traditional econometric approach and SVMs in regression approximation tasks. This problem was readily solved by a SV regression with excellent performance at is it clear from Table 1. Based on comparison of the coefficients of determination and preliminary experimental analysis illustrated that the utilization of SVR could provide a significant boost in increasing the approximating performance.

The use of SVR is a powerful tool to the solution of many economic problems. It can provide extremely accurate approximation of time series, solutions to many problem are global and unique. However, this approach is not without limitations. In general, as can be seen from equations (4), the matrix size in the quadratic programming problem is directly proportional to the number of training data and they are also many types computing problems General quadratic program become intractable in the memory and time requirements. For these reason, the generalization version of the decomposition strategy is proposed by Osuna (1997), the so called SVM^{light}. Another limitation is, that it is no interpretation of hyper-parameters.

Acknowledgements

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Analysis of the Characteristics of the Cyberphysical System for Growing Vegetables

Andrii-Volodymyr Midyk [1], Olha Lysa [2],

Abstract. The article substantiates the urgency of developing a cyberphysical system of growing vegetables with regulation of heat-moisture-insolation regime to increase production efficiency in the greenhouse. The main information parameters of the microclimate of greenhouse premises are determined, in particular: air temperature, relative humidity, illumination of the greenhouse room, soil temperature, soil moisture, concentration of carbon dioxide in the greenhouse. As a result of the research the choice of smart sensors and their placement in the greenhouse is substantiated. A working model was made and tested. To assess the uniformity of the temperature in the greenhouse and the choice of the location of the device sensors, the temperature and humidity were measured in a stabilized mode.

Keywords: cyber-physical system, microcontroller, sensor, actuator, temperature, humidity, light, PID-controller.

JEL Classification: C69, C99

1 Introduction

Any cyberphysical system is a system that is controlled and monitored by computer algorithms, a system that can receive information from the environment with the help of sensors, process it independently and change its actions in accordance with this information. Therefore, when it comes to creating a cyberphysical system for growing vegetables, we note that it has a controlled state of microclimatic conditions inside the greenhouse and outside with a system of sensors, process information from sensors using computer algorithms, and control the executive elements according to processed information. The main information parameters of the microclimate of greenhouses are: air temperature, humidity, greenhouse lighting, soil temperature, soil moisture, carbon dioxide concentration in the greenhouse,

[1] National University "Lviv Polytechnica", department of Information-measuring Technologies, 12, S. Bandera st., L'viv, 79013, Ukraine, andriy31194@gmail.com.
[2] Lviv National Agrarian University, department of Computer-Integrated Technologies, 1, Volodymyra Velykogo st., Dubl'iny, 80381, Ukraine, olal31194@gmail.com.

as well as external weather conditions and design parameters of the greenhouse.

The purpose of the research is to improve the microclimate management system in the greenhouse using modern microprocessor controllers and control and measuring devices to improve the performance of economic entities.

2 Functional diagram for microclimate control in greenhouses

The efficiency of greenhouse production depends on the microclimate in the greenhouse, and hence the operation of control and measuring devices, automatic control systems, actuators, which together provide the desired microclimate for growing plants. The optimum temperature promotes the active process of photosynthesis. Its fluctuations negatively affect the growth and development of plants, and often leads to their defeat by diseases. Therefore, to increase the efficiency of greenhouses, it is advisable to analyze a set of parameters of microclimatic conditions of greenhouses, improve the element base, which forms the primary information about the microclimate in the greenhouse, and the element base that maintains the desired microclimate.

The main principle of operation of the microclimate control system in the greenhouse is the start / shutdown of electrical equipment based on the processing of measurement data from sensors. For these data to be reliable, the sensors must be highly accurate and optimally placed inside and outside the greenhouse. The sensors inside the greenhouse are located in such a way that they are not affected by automation and control. The number of sensors depends on the dimensions of the greenhouse. Automation of design of microclimate control systems is developing in connection with the achievements of modern microelectronics.

Analysis of microclimatic conditions of greenhouses, as follows from the needs of regulation of microclimatic indicators, it is advisable to carry out the following set of parameters: air temperature in the greenhouse; humidity in the greenhouse; greenhouse lighting; soil temperature; soil moisture; the concentration of carbon dioxide in the greenhouse. In addition, the external weather conditions and design parameters of the greenhouse are analyzed.

To design a cyberphysical system for growing vegetables, the Arduino Uno board is used, which is a device based on the ATmega328 microcontroller, and can smoothly regulate temperature and humidity while maintaining sufficient accuracy of the supported parameters, is energy efficient and cheap. Based on the analysis of technical characteristics of sensors and research with them, the following sensors of cyberphysical vegetable growing system were selected, in particular temperature and humidity sensor (DHT21 / AM2301 and DHT22 - digital sensors with high accuracy with capacitive humidity sensor and NTC thermistor), greenhouse light sensor room (BH1750), soil temperature sensor (DS18B20) and capacitive soil moisture sensor (not susceptible to corrosion and therefore independent of soil salinity), sensor greenhouse gas concentration (MG-811, MH-Z19B).

The microprocessor system based on the Arduino UNO board allows to implement measuring devices with microprocessor control, which can include motors and sensors. All components of the cyberphysical system are energy efficient and cheap.

Functional diagram for microclimate control in greenhouses is shown in Fig.1.

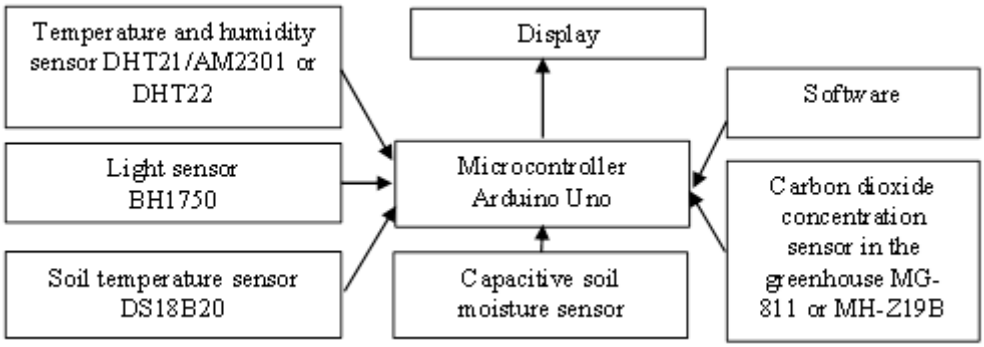

Figure 1 Functional diagram for climate control in greenhouses, Source: own.

This choice of sensors is due to the following analysis of their characteristics.

Arduino boards have a relatively low cost: ready-made Arduino modules cost up to $ 50, and the ability to assemble the board manually allows you to save as much money and get an Arduino for the lowest price. Arduino devices are based on Atmel ATmega328 and ATmega168 microcontrollers. Using

Arduino module diagrams published under a Creative Commons license, developers can create their own versions of devices based on existing savings. The use of microprocessors in the automatic control systems of greenhouses provides a reduction in the cost of systems by an order of magnitude compared to systems on elements of small and medium degree of integration, which implement similar functions.

3 Research and analysis of the characteristics of the greenhouse microclimate

Building a quality automated microclimate control system begins with the identification of the control object. To substantiate the rational scheme of automatic regulation, the choice of the type of regulator and its correct setting, knowledge of static and dynamic characteristics of the process of growing plants in the greenhouse as an object of automation is required.

In principle, the study of static and dynamic patterns is possible both theoretically and experimentally. In the first case, the equations of dynamics and statics are based on the analysis of physical processes that take place in the object, and the application of the laws of conservation of energy and matter. But to determine the coefficients of the equations requires the setting of special labor-intensive laboratory tests. Experimental methods require minimal data on the nature of the processes occurring in the studied objects, and at the same time allow to determine with acceptable accuracy the coefficients of differential equations of dynamics or coefficients of transfer functions of automation objects. These methods are easy to use and allow you to get a mathematical description of an object relatively quickly. An acceleration curve is constructed during the experimental study of the microclimate control object. To get it, you need to step on the entrance of the object. Determine the factor that affects the adjustable value. The input action is changed by a jump by 10–20 percent of the actuator stroke and the change of the adjustable value is observed. Next, a mathematical model is built in which the transient process coincides best with the experimental acceleration curve with a step change of the input value.

The greenhouse research program included the study of the object of regulation in different modes of operation, as well as the justification of the location of temperature and humidity sensors in the greenhouse. On the basis

of these researches the substantiation and synthesis of rational systems of automatic regulation of the studied process was provided. The distribution of temperature and relative humidity of the greenhouse was studied in spatial coordinates.

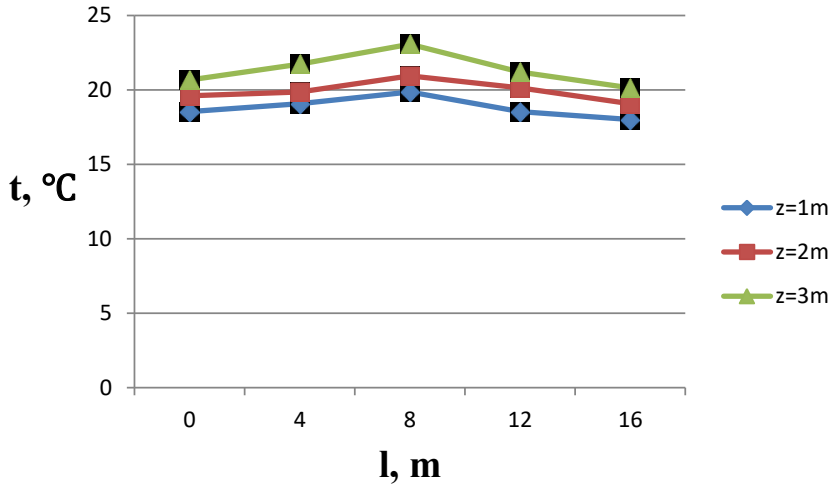

Figure 2 Change of temperature t of air on height (z) and length (l) of the greenhouse (measurements are carried out by the humidity and temperature sensor DHT21/AM2301),

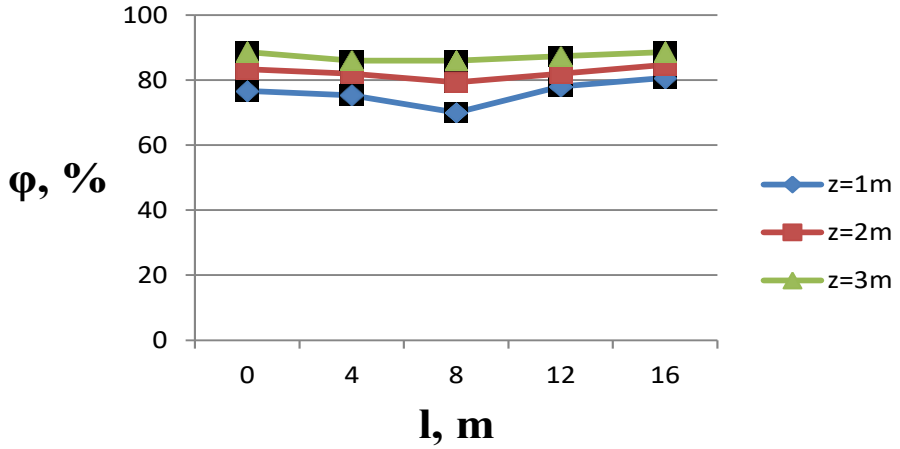

Figure 3 Change of relative humidity φ of air on height (z) and length (l) of the greenhouse (measurements are carried out by the humidity and temperature sensor DHT21/AM2301), Source: own.

According to the measurements, graphs of changes in temperature and relative humidity were constructed (Figs. 2, 3). They show that the air

parameters change in the space of the greenhouse. Towards the center of the greenhouse, the air temperature rises slightly and the humidity decreases. The decrease in temperature increase in the relative humidity of the air near the walls of the greenhouse is due to the fact that due to heat exchange with the outside air there is heat loss. The greatest decrease in temperature is in the place of installation of doors that is caused by their leak. The highest value of temperature and the lowest - humidity was recorded in the center of the greenhouse at a height of 3 m. Therefore, the center of the greenhouse was chosen for the installation of measuring sensors. The height of placement is determined by the position of point A (Z = 2m), in which the average relative to the limit deviations of the devices were recorded. The obtained data give grounds to consider the greenhouse as an object with concentrated parameters.

The dynamic properties of the investigated greenhouse were determined by removing the transient characteristics when applying an abrupt effect separately for each of the parameters of the input group during a pre-stabilized process.

The Arduino Uno board, which is a device based on the ATmega328 microcontroller and can smoothly regulate temperature and humidity while maintaining sufficient accuracy of the supported parameters, was used to design the cyberphysical system for growing vegetables. In the course of work the microcontroller according to the set program, taking into account external conditions carries out the coordinated management of executive mechanisms. A working model was made and tested. To substantiate the parameters of the automatic control system for growing vegetables, we use mathematical and computer modeling of the dynamics of thermal processes using the equations of heat balance. The control function is provided by the PID controller, the main task of which is to regulate temperature, humidity, insolation with minimal error relative to the set mode.

4 Conclusion

1. The main information parameters of the microclimate of greenhouses are: air temperature, relative humidity, illumination of the greenhouse, soil temperature, soil moisture, carbon dioxide concentration in the greenhouse.

2. The Arduino Uno board, which is a device based on the ATmega328 microcontroller and can smoothly regulate temperature and humidity while maintaining sufficient accuracy of the supported parameters, was used to design a cyberphysical system for growing vegetables.
3. A working model was made and tested. To assess the uniformity of the temperature in the greenhouse and the choice of the location of the device sensors, the temperature and humidity were measured in a stabilized mode.
4. To substantiate the parameters of the automatic control system for growing vegetables, we use mathematical and computer modeling of the dynamics of thermal processes using the equations of heat balance. The control function is provided by the PID controller, the main task of which is to regulate temperature, humidity, insolation with minimal error relative to the set mode. The PID controller generates an output control signal.

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Virtual instrument for determining the content of heavy metals in the juice

Ihor Midyk [1]

Abstract. For imitative control of vegetable juice quality indicators, a virtual measuring instrument based on the LabVIEW hardware and software platform and a compatible NI USB 6009 unit has been proposed, developed and implemented. The imitative method is based on measuring the electrical conductivity of control objects. A sinusoidal test signal in the form of an alternating voltage with an amplitude of 10-20 mV was generated to measure and calculate the imitance of the object. To generate alternating voltage, the program uses elements of the NI-DAQ problem with the While Loop with Stop Button cycle. Create Channel is created. Reading and processing of complex components of imitation is carried out according to the module and active component of imitation. The virtual device in the PC with the LabVIEW software, the NI USB 6009 block and a conductometric cell with juice is intended for determination of the content of heavy metals in juice.

Keywords: immitance, impedance, virtual instrument, LabView graphics platform, DAQ task software.

JEL Classification: C53

1 Introduction

Modern measuring instruments are complex multicomponent devices and systems that perform the following functions: a) the primary conversion of physical quantities into electrical ones; b) pre-processing of electrical signals; c) analog-to-digital and digital-to-analog conversion; d) digital data processing; e) data registration; f) presentation (visualization) of information; g) network communications; h) control of the measurement process.

Some of these functions can be implemented only by hardware, while the functions of data processing, visualization and registration, control and communication can be performed by both purely technical and software-hardware means (specialized controllers or computers). By means of the software interaction of various knots of system is carried out, their necessary

[1] National University "Lviv Polytechnica", department of Information-measuring Technologies, 12, S. Bandera st., L'viv, 79013, Ukraine, midykihor@gmail.com,

functionality, flexibility and other qualities are reached. Therefore, software is an important component of measuring systems.

Most hardware can be assembled by selecting existing elements and devices, and the most difficult stage of designing measuring systems is the development of application software. To simplify this step allows you to use the graphical programming system LabVIEW (Laboratory Virtual Instrument Engineering Workbench). LabVIEW system - designed to create tools for automation of measurement and control, has properties that distinguish it from traditional programming languages.

The subject of the study is the development of a virtual device for determining the content of heavy metals in the juice. The purpose of the research is to develop a method for conducting rapid analysis of juice for mineral content by electrical parameters.

To achieve this goal, the following tasks were solved:

- to generate a test signal for imitation measurements;
- to measure immittance by means of the NI USB 6009 block.

2 Software and hardware generation of a test signal for imitation measurements

LabVIEW is a development environment and platform for executing programs created in the graphical programming language "G" by National Instruments (USA). They are used in data collection and processing systems, as well as for the control of technical objects and technological processes, ie they are ideally suited for exploitation in the newly created subsystems of cyber-physical systems related to measuring instruments. Thanks to interactivity and the ability to use optimized available multifunctional I / O devices - such as NI USB-6009, LabVIEW greatly simplifies the development and creation of unique virtual measuring instruments (if you have a PC with software installed), otherwise if you have a hardware and software platform LabVIEW.

The NI USB-6009 has digital I / O, analog I / O and a 32-bit counter. USB-6009 is an ideal solution for tasks such as portable measurements, simple data logging and experimental research in an academic laboratory. Because LabVIEW provides connectivity to virtually any measurement tool,

you can connect new LabVIEW applications to existing tools without investing in additional hardware.

Regardless of hardware requirements, LabVIEW provides an interface for I / O connection. When using the NI USB-6009, which is able to work from the PC bus and provide a reliable connection to the sensors with screw terminals, the necessary virtual measuring instrument is implemented, for example, the virtual measuring instrument required to determine the content of harmful impurities in vegetable juice.

To perform this interference, it is advisable to use the NI-DAQmx software interface of the LabVIEW platform, which can be used to communicate with data collection devices. Explorer (MAX) is a tool that is automatically installed using NI-DAQmx and used to configure National Instruments hardware and software.

Thus, for imitative control of vegetable juice quality indicators, a virtual measuring instrument developed and implemented on the basis of the LabVIEW hardware and software platform and the compatible NI USB 6009 unit is proposed and implemented in this work. as a result, you can quickly control the quality of vegetables from which the test juice is obtained, in production conditions at low cost.

To measure and calculate the immittance of vegetable juice you need to generate a test signal - AC voltage with an amplitude of 10-20 mV. To do this, follow these steps:

- generate a test signal (sine wave);
- read complex values of immittance.

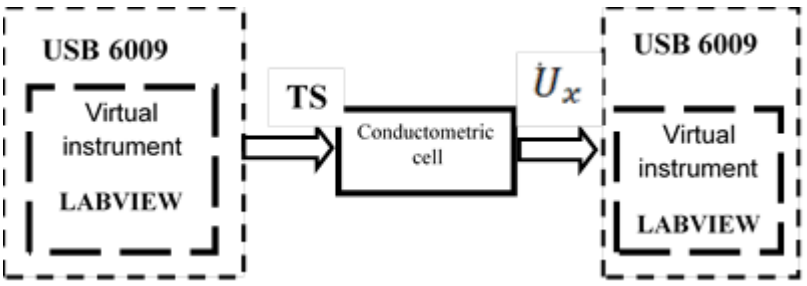

Figure 1 Block-scheme for measuring the immitance of juice of vegetable products, Source: own.

TS – test signal, $\dot{U}_x$ – voltage at the measuring object.

The block-scheme of measuring the immittance of vegetable juice is given in Fig.1.

The created device allows to generate electric voltage in the range 0… 5 V. At the same time, the program deduces a sinusoidal signal with voltage shift and allows the user to choose the number of points per cycle. Increasing the dots per cycle increases the resolution of the output signal, but decreases its frequency. The approximation period of the output signal is equal to the number of points per cycle multiplied by the time norm.

In practice, the frequency of the sinusoidal test signal was set indirectly through the interval and number of points. It was evaluated in the program approximately.

The created virtual means of measuring the immittance of non-electric objects is shown in Fig. 2, right. Here, in particular, you can see a PC with installed software, the NI USB 6009 unit, which is used to generate a sinusoidal signal and supply it to a container with electrodes filled with juice or model solution; The same unit is used to measure immittance.

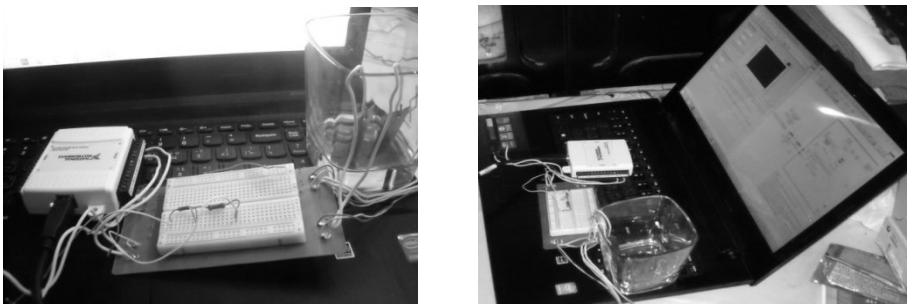

Figure 2 Virtual means of generating sinusoidal voltage and measuring the immittance of non-electric objects (juices), Source: own.

3 Immittance measurement using a block NI USB 6009

A typical immittance measurement requires one measuring transducer to measure the voltage at the load terminals and a second transducer to measure the current flowing through the object.

However, the actual calculation of the immittance depends on the resistive and reactive components (capacitors and / or inductors) in the circuit. Reactive components lead to a phase shift (up to 90 degrees) between the generated voltage and current signals. This phenomenon is represented by

three different representations of imitance: the active component, the module and the reactive component.

There are two different methods that are used to measure the active impedance component. The first method is to take the time value of the instantaneous product of voltage and current to calculate the active power and then divide it by the square of the RMS current (the square of the rms current). Another way is to use the impedance angle depicted in the immittance triangle. The cosine of the impedance angle, directly proportional to the active resistance in the circuit, is called the impedance coefficient.

Reactive components cause a phase shift (up to 90 degrees) between voltage and current. The current and voltage waveforms will have a phase shift between 0 and 90 degrees. To measure the reactive component, the following capabilities are required: the ability to obtain a voltage and current signal; simultaneous receipt of both measuring signals; both meters must receive signals simultaneously. The virtual immittance measuring tool includes a collection of virtual devices that work with DAQ hardware devices.

For a single-phase circuit that operates at a constant sinusoidal wave velocity, the voltage and current have the following expressions:

$$u(t) = U\sqrt{2}\sin\omega t \quad (1)$$

$$i(t) = I\sqrt{2}\sin(\omega t - \varphi) \quad (2)$$

For AC systems, it is necessary to receive signals with amplitude from the range used at the system input. By Bobalo YU relation (3) defines the active component as the active power divided by the square of the current:

$$R = \frac{\frac{1}{T}\int_t^{t+T} u(t)\cdot i(t)dt}{I^2} \quad (3)$$

For AC systems, it is necessary to receive signals with amplitude from the range used at the system input. Relation (3) defines the active component as the active power divided by the square of the current [10]:

$$|Z| = U_д/I_д \quad (4)$$

Taking into account these connections, two input sections are defined: one for voltage and the other for current.

To calculate the RMS values of voltage and current used to measure the amplitude and level, which are in the subpalette of functions "VI Express" Signal analysis, by dividing the RMS values of voltage and current, the modulus of impedance Z is obtained (Fig. 3).

By multiplying the instantaneous values of voltage and current, and then mediation and passing through a low-pass filter (Express Filter VI), we obtain the active power, and then the active component R (Fig. 4).

The reactive component is determined by the ratio:

$$X = \sqrt{Z^2 - R^2} \tag{5}$$

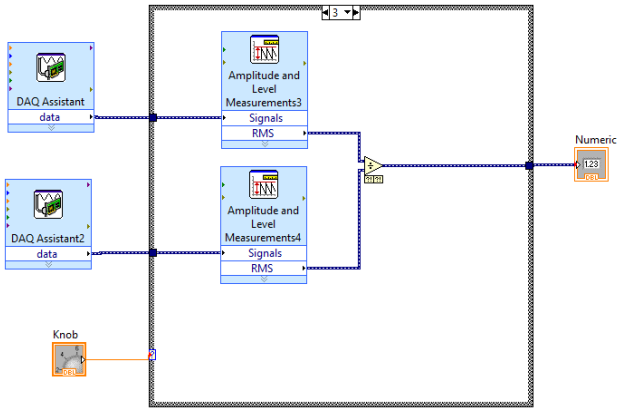

Figure 3 Block diagram for calculating the impedance modulus, Source: own.

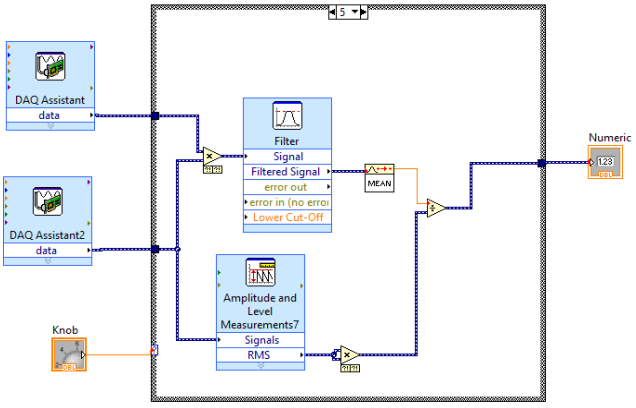

Figure 4 Block diagram for calculating the active component of the impedance, Source: own.

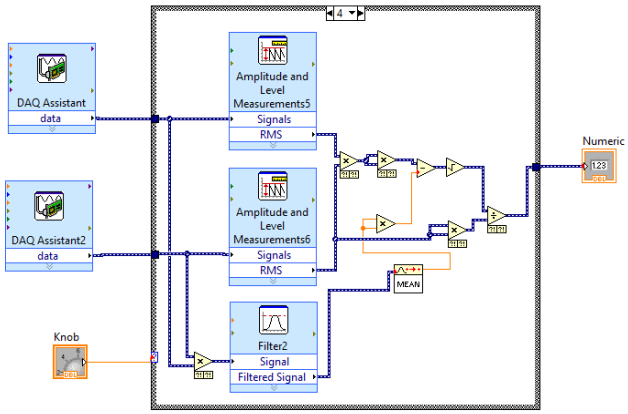

Figure 5 Block diagram for calculating the reactive component of the impedance, Source: own.

The device (Fig. 4, 5) used:

- Filter to obtain the integral of the product of the voltage and current values of the object of study;
- MEAN to calculate the average value over the period from the filter data;
- Amplitude and Level Measurement to obtain the current value;
- DAQ Assistant to obtain the original voltage and current values of the object of study.

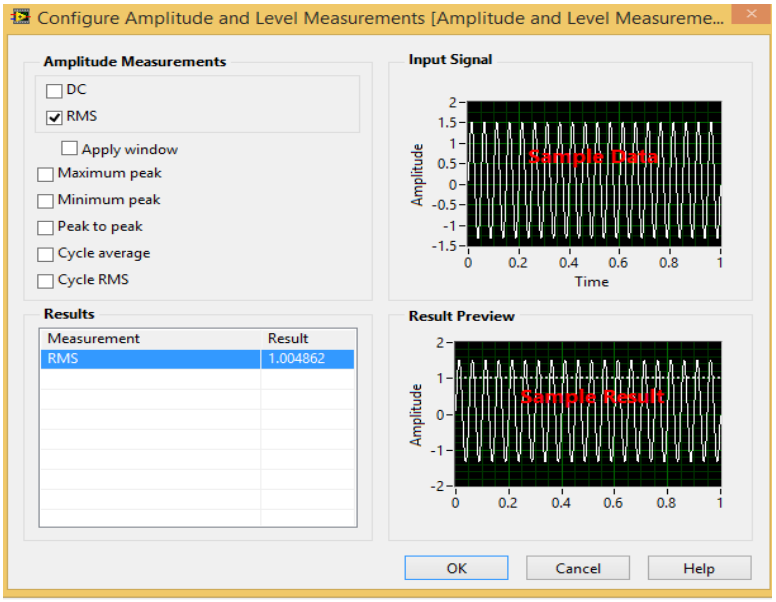

Figure 6 Amplitude measurement setting window, Source: own.

This analysis of voltage and current measurements is used to calculate the modulus of impedance. The RMS option is selected in this window. The output is the root mean square value of the voltage or current signal.

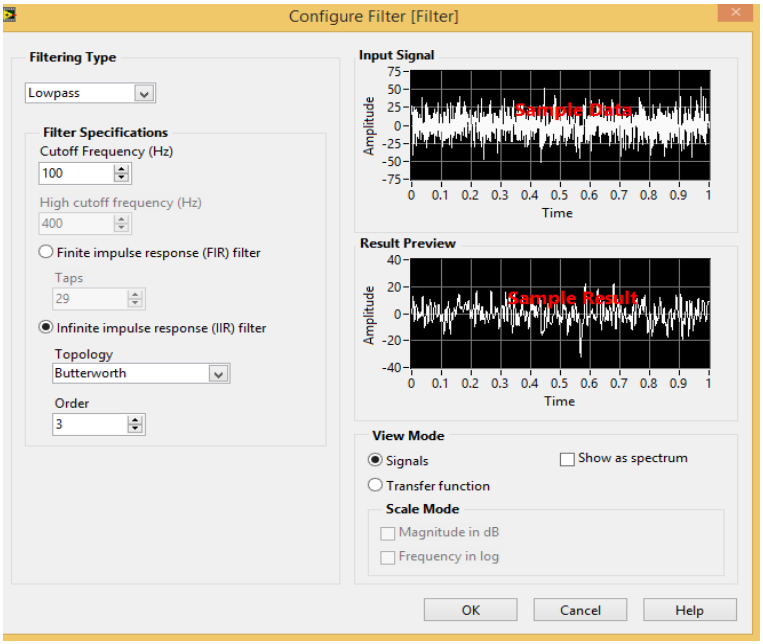

Figure 7 Electric filter settings window, Source: own.

The electric filter of the hardware and software platform is used to calculate the active component of the impedance. In the window you can select the filter type, operating frequency range, etc.

The LabVIEW hardware and software platform includes Explorer & Measurement & Automation Explorer (MAX), which sets all device and channel configuration parameters. For example, DAQ Assistant is a graphical interface for interactively creating, editing, and running NI-DAQmx virtual channels and tasks (a set of functions for collecting data). The NI-DAQmx virtual channel consists of a physical channel on the DAQ device and configuration information for that physical channel, such as input range and special scaling. NI-DAQmx is a set of virtual channels, time and start of information, as well as other properties related to reception or generation.

Figure 8 shows the NI-DAQ Assistant configured to perform voltage measurements.

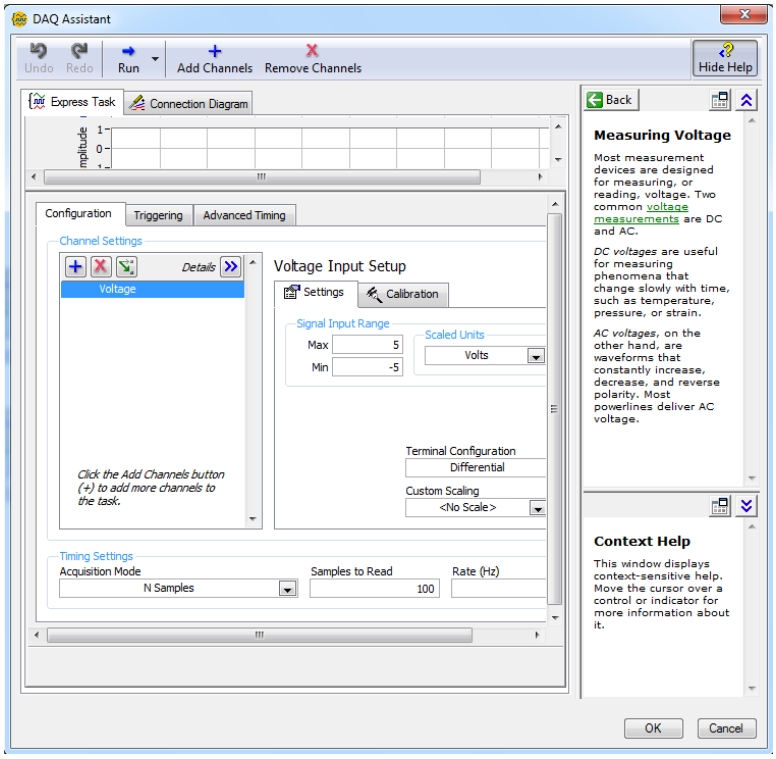

Figure 8 NI-DAQ Assistant settings, Source: own.

4 Conclusion

1. For imitative control of vegetable juice quality indicators, a virtual measuring instrument based on the LabVIEW hardware and software platform and a compatible NI USB 6009 unit has been proposed, developed and implemented.
2. A sinusoidal test signal in the form of an alternating voltage with an amplitude of 10-20 mV was generated to measure and calculate the imitance of the object. Because the NI USB 6009 is not able to generate AC voltage, the program uses some elements of the NI-DAQ task with the While Loop with Stop Button cycle. To do this, create a generation channel Create Channel (start generation Start, write voltage generation, clear task Task), as well as Wait, which regulates the sine wave period.
3. Reading and processing of complex components of immittance was performed by module and active component of immittance (to obtain the value of the module of immittance used Amplitude & Level measurement → RMS (root mean square), and to obtain the active component of

immittance - Filter i mean). In this case, the reactive component of immittance is calculated algebraically.

4. A virtual device consisting of a PC with LabVIEW software, a NI USB 6009 unit and a juice conductivity cell is used to determine the content of heavy metals in this juice. This made it possible to perform a rapid analysis of the juice for mineral content by electrical parameters. Thus, in production conditions at low cost, you can quickly control the quality of vegetables from which the juice is obtained.

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Implementation of information technology for Practice in energy 2020

Radoslav Potoma[1], Zuzana Rudášová[2], Tomáš Pala[3]

Electricity generation as part of the energy industry plays an irreplaceable role. The energy and energy industry in each country is extremely important and economically demanding, both in terms of technology, but especially in terms of the environment, as all EU countries have agreed and signed the Carbon Neutrality Treaty until 2050. In the future, energy industry will increasingly rely on digital intelligence and the use of data analysis for more efficient use of resources. Smart sensing technology responds and communicates with the environment, optimizes performance, improves quality and increases the efficiency of the entire production process from the input of production factors through technology innovation to the distribution of electricity through the distribution network. In this paper, we focus mainly on increasing the quality of electricity generation processes in a thermal power plant in the country. One option is to replace coal with another suitable alternative fuel that would ensure at least the same quality of the final product of the production process. The work will be focused on the economic aspects of finding new sources of technologies or procedures that would be sustainable in terms of the required volumes of reasonable price, minimum and acceptable negative impact on the environment. One of the most possible, resp. the most suitable alternatives are economic recovery of waste.

Keywords: energy, technologies, digital intelligence, quality

JEL Classification: Q42, Q43, Q47

[1] University of Economics in Bratislava, Faculty of Business Economy with seat in Košice, Department of Quantitative Methods, Tajovského 13, 041 30 Košice, e-mail: radoslav.potoma@euba.sk

[2] University of Economics in Bratislava, Faculty of Business Economy with seat in Košice, Department of Quantitative Methods, Tajovského 13, 041 30 Košice, e-mail: zuzana.rudasova@euba.sk

[3] Technical University of Ostrava, Faculty of materials science and technology, Department of Economics and Management in Industry, 17. listopadu 2172/15, 708 00 Ostrava – Poruba, e-mail: tomas.pala.st@vsb.cz

1 Introduction

The current situation in the energy industry and ecology is putting increasing pressure on the reuse or recovery of waste, because the amount of waste produced in this sector is not negligible and therefore the reuse of waste products from production is very important to ensure the sustainability of production technology. Coal had, has and will have an irreplaceable place both in the domestic energy sector and in the whole world and especially in less developed countries, where the advent of modern technologies is not yet possible due to the bad situation in the country. Based on this information, it is important in the future to develop new technologies that will increase the efficiency of thermal power plants and minimize the harmful effects of burned black and brown coal. Thanks to this fact, there is room for research, development and production of solid secondary fuel (alternative fuel) and its further possible use in practice on the basis of saving both economic costs and the environment. New technologies entering everyday life have not escaped the energy industry either. The goal is to maximize the opportunities arising from the advent of big data and intelligent systems. Creating a smart infrastructure with integrated digital intelligence is changing the way energy is generated, distributed, processed and stored. These intelligent solutions are the driving force behind efficiency. In the future, energy will also increasingly rely on digital intelligence and the use of data analysis for more efficient use of resources. Intelligent sensing technology responds and communicates with the environment, optimizing performance and increasing efficiency. In the next part of the paper, we will present five solutions that are transforming the energy industry and are an opportunity for innovation.

2 Possibilities and benefits of incineration of plastic waste from landfills

One of several possible solutions for reducing landfilling in the country as well as in the whole country and in the world is its subsequent incineration and its energy recovery, where several problems are solved at once. The number of landfills will be reduced, or the volume of landfills will be reduced, waste will be recovered, which will then be used as a fuel for the production of electricity or thermal energy, and the environment will be protected by stopping the generation of greenhouse gases in the landfill.

Waste incineration is basically the only way to dispose of some waste from medical facilities or the chemical industry. Incineration technologies can be applied to various types of waste, whether municipal, industrial, agricultural, or other and hazardous waste. Some chemicals in the plastic incineration process can produce harmful emissions and therefore waste containing hazardous substances needs to be sorted and identified and excluded from the incineration process before incineration. The most modern waste sorting equipment includes a technological line for automatic optical sorting of plastic waste using a ballistic separator. The optical drive can distinguish individual commodities based on the type of plastic and color. By using the new technology, we expect a reduction in the share of waste from sorting, which in the past was at the level of 40-50%. According to several renowned authors, Optical sorting systems and incineration systems for waste treatment, which are also used by the Haraldrud and Klemetsrud plants operated by the Waste Energy Agency in Oslo, are one of the best alternatives to waste recovery for electricity generation.

3 Processes of combustion of individual commodities

The waste incineration process, in which the waste is kept in a furnace inside the furnace and the transfer of heat to the waste is supported by sand or other bed material (so-called fluidized bed). It is used when the waste is quite homogeneous or pre-sorted. With optimal configurations, the energy yield is higher than with mobile grate combustion. Based on this information, according to foreign authors who have devoted countless significant research to this process of incineration and recovery, the best system is to burn this waste using a fluidized bed boiler using a fluidized bed as an innovation of the original information systems for higher process efficiency. In the case of incineration of waste (plastics) on a movable grate and in a fluidized bed, it is possible to achieve 15 to 30% electrical efficiency and 60 to 85% thermal efficiency. In the case of co-incineration of plastics in power plants, it is possible to achieve 35 to 45% electrical efficiency and thermal efficiency up to 35%. Within fluidized bed reactors, we distinguish the so-called a bubbling reactor (a), a circulating reactor (b) and a dual reactor (c), which are shown in the following figure.

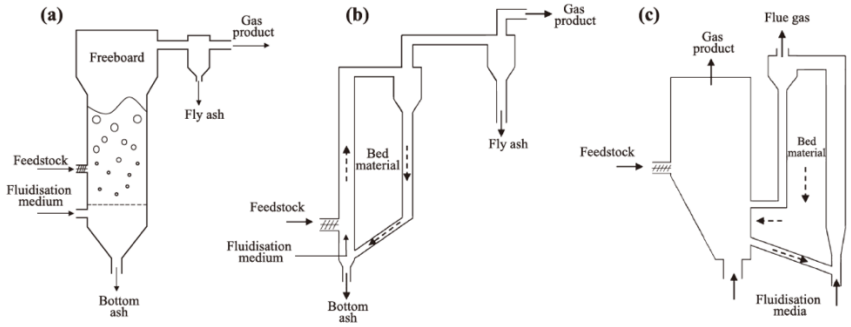

Figure 1 Fluidized bed reactor configurations, Source: Prepared according to Iannello et al., 2020

A circulating fluidized bed boiler is a unique type of boiler that is able to burn problematic fuels with different composition and density, moisture content, calorific value and ash content, due to the high thermal capacity of the bed. This innovative system uses sand as a fluidizing medium to create a more even distribution of the fuel supplied. Sand is, of course, needed in different fractions according to the size of the circulating bed.

4 Combustion

An overview of the comparison of produced emissions from coal combustion and from combined combustion of coal and biomass in a ratio of 50:50 is provided by a study during a test operation of a boiler in one unnamed company in the country.

Tab. 1 Emission values and emission limits for coal combustion
Source: Prepared according to Smarž, 2015

Explanations: TZL - solid pollutants; NO_x - nitrogen oxides; CO - carbon monoxide; SO_2 - sulfur dioxide.

Measured component	**Average value**	**Emission limit**
	$mg.m^{-3}$	$mg.m^{-3}$
TZL	90	100
NO_x	580	600
CO	159	250

CO_2	1075	1700

Tab. 2 Emission values and emission limits for combined combustion of coal and biomass in a ratio of 50:50; Source: Prepared according to Smarž, 2015

Measured component	**Average value**	**Emission limit**
	$mg.m^{-3}$	$mg.m^{-3}$
TZL	26	100
NO_x	417	600
CO	147	250
SO_2	1119	1450

This confirmed the theoretical assumptions that the more biomass we use in co-incineration with coal, the more environmentally friendly combustion. Research has also shown that burning biomass and coal reduces CO_2 emissions.

5 Requirements and obligations for environmental and air protection

Requirements for air protection in the conditions of the Slovak Republic are regulated primarily by Act no. 137/2010 Coll. on Air and Decree of the Ministry of the Environment of the Slovak Republic no. 410/2002 Coll., Which implements certain provisions of the Air Act. Given that secondary fuel means a fuel produced from waste that has reached the end of waste status according to the Waste Act and is no longer considered as waste, but as a substance, mixture or product according to a special regulation, the requirements for combustion plants apply to the combustion of secondary fuels. One of the goals is to minimize the negative impacts of the energy industry in the form of coal combustion and waste management on the environment and the health of the population. As a result of the

implementation of the proposed activity of energy recovery of solid secondary fuels, there is a realistic assumption that the quality of most components of the environment will improve, which in turn will also make a positive contribution to improving the health of the population in the region. In the field of waste management, the direct positive effects will be mainly due to the reduction of the amount of municipal waste deposited in landfills and the increase of the recycling rate of this waste. Instead of ending up in landfills, it will be necessary to first sort it and then process it into a solid secondary fuel, which will then be recovered for energy in the plant's combustion plants. The Slovak Republic is forced to increase the efficiency of waste management, as the Slovak government has committed itself to reducing landfilling to 10% by 2035, and emphasis must also be placed on waste prevention and recycling. In Slovakia in 2018, an average of 414 kg of waste per person was produced. Of this amount, only 23% of the waste was recycled, but up to 66% of the waste was disposed of by landfilling. A similar commitment arises for the Slovak Republic also in connection with CO_2 emissions, which need to be reduced by at least 40% by 2030 compared to the 1990 level in accordance with EU regulations.

6 Conclusion

Given the overall world development, it is clear that the production of electricity from coal is slowly coming to an end in Europe as well, especially in Slovakia. Global warming is forcing the world's economies to look for sustainable, economically viable solutions that, on the one hand, meet the ever-increasing demand for energy while preventing the devastating environmental impact of the energy production in question. Developments in recent years have shown that a simple continuous process of improving the quality of coal-fired power generation, with very severe constraints in place, cannot be sufficiently efficient and necessarily leads to economic losses. Therefore, it is necessary to look for new sources that would ensure sufficiently efficient quality of electricity production, both in terms of applicable legislation, standards, and customer requirements. One possibility is to replace the coal with another suitable fuel, which would ensure the quality of the final product.

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Application of software for prediction and cost optimization

Ing. Lenka Tkačíková, Ph.D.1, Ing. Ivana Osičková2

Abstract. In business practice, it is necessary to manage costs, because the amount of costs affects the amount of profit of the company. Businesses have variable and fixed costs. Fixed costs do not change with production volume and are therefore easier to predict and optimize correctly. In contrast, variable costs change with the volume of production, and it is therefore more difficult to predict and optimize them. Manufacturing companies must constantly monitor their variable costs. One way to predict and optimize a company's variable costs is to use software that monitors electricity consumption. The aim of this article is to define the possibility of applying the program to monitor energy consumption in the company. By applying the program in the company, it is possible to determine the energy consumption of individual consumption points, ie equipment and also to analyze the measured values to forecast the consumption of variable costs, electricity for the next period.

Keywords: Costs, company, electrical energy, software.

JEL Classification:

1. Introduction

The higher the cost, the more the profit of the community, so it is desired that the employer should keep all the costs, so that they may be the lowest. Cost optimization is a complex process, from the point of view of manufacturing companies, costs are most often divided into fixed and variable. Fixed costs can be calculated sufficiently accurately, but variable costs must be predicted (Bartusková, 2012).

The predictions of the selected variable costs can be aided by software settings that characterize energy consumption and expected values are useful for future waste and forecasts for calculating specific variables. One such program is Max communicator 9, which is optimal for small and medium-

[1] VŠB-TUO, HGF, Institut ekonomiky a systémů řízení, 17. listopadu 2172/15, 708 00 Ostrava-Poruba, l.tkacikova@seznam.cz

[2] VŠB-TUO, HGF, Institut ekonomiky a systémů řízení, 17. listopadu 2172/15, 708 00 Ostrava-Poruba, ivana.osickova@vsb.cz

sized businesses. The program provides a comprehensive overview of energy supply and mediation reports to help predict energy costs for the future.

2. Costs

The product encompasses all economic activities combined with the protection of products and services, as well as the processing of non-ferrous raw materials and materials for financial products. The scrap process of non-foggy raw materials requires a pile of wet pads on the road and requires high production costs. The division of charges on such transports is carried out in accordance with the volume of performance. This layout is considered to be the most important design of its design. The costs for their dependence on the volume of executions are divided into fixed costs and variable costs (Lazar, Matušková 2012).

Fixed costs are costs that do not increase with the volume of the product. A typical example of fixed costs is leasing, depreciation, wages. Variable costs are costs that change with the production volume. A typical example of variable loads is energy consumption (Synek, Kislingerová, 2015).

With a gravel sand mining wet road with an annual capacity of around 240,000 tones, the load is 35% fixed and 65% variable. It is necessary to know about the past use of variable costs about planning and prediction of costs. For example, electricity consumption accounts for about 15% of variable costs. It is then necessary to measure the electricity and further energy used in the product and to measure its consumption.

Not only does the company's management want to reduce costs, but globalization and the state of the environment are forcing manufacturing companies to reduce energy and water consumption. Energy supervision in production without measurement is inefficient. The company will achieve significant savings in variable costs mainly thanks to effective regulation and prediction of energy. One way to monitor vigorously and keep track of energy consumption is to use enterprise energy software. The comprehensive program for corporate energy is Max communicator 9.

3. Max communicator 9

Max communicator 9 is a program for corporate energy. It is a software superstructure of a complex system of measurement and regulation, the course of energy consumption, which consists of a system of meters (electricity meters, gas meters), control stages and equipment for measurement and regulation. The software monitors the consumption, energy supply, status and course of regulation, archives the measured values and performs their evaluation. It also gives the user the opportunity to actively enter the control system. The program is clear thanks to the system of bookmarks, it is oversized and its control is intuitive. The user can use the movable panels to determine which quantities he still has visible and which visible only after clicking. The program is adapted to a large number of sampling points, there can be hundreds of meters in each plowing point, including non-electrical quantities (water, temperature). Sampling points can be arranged in a hierarchical structure and grouped. At the same time, they allow you to display total consumption diagrams. (Kobert, 2014).

The picture contains a preview of the current values of all measurements (left), an overview of the instantaneous values of the transfer measurement, including a brief history, the course of measurement and regulation of ¼ hours power (reserved capacity) and the status of control stages (right).

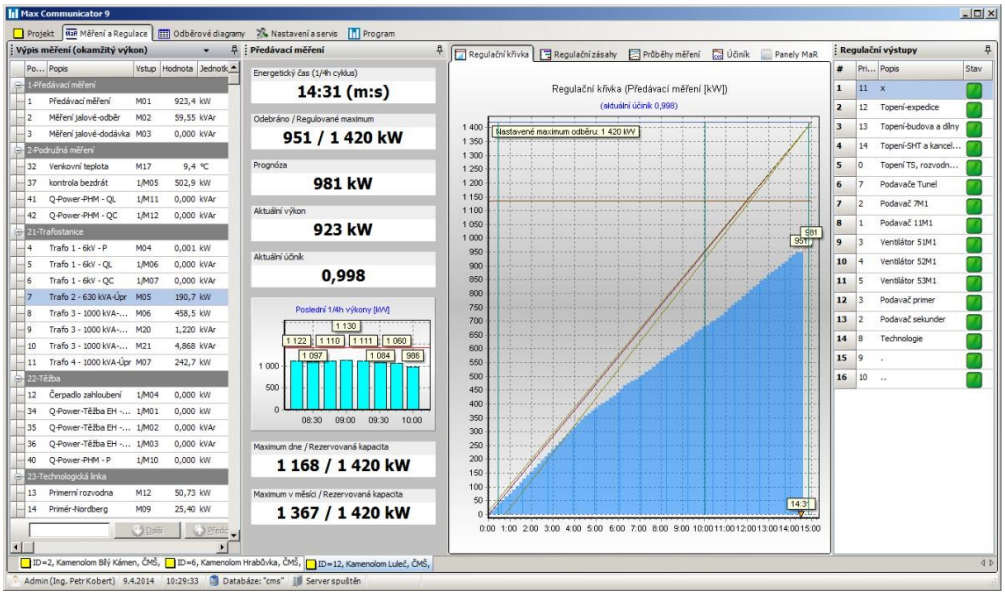

Figure 2 Preview of the current measurement in the program Max communicator 9 (Kobert, 2014)

It is intended for small and medium-sized enterprises that need to ensure comprehensive energy supervision and management of the course of consumption:

- Electric energy,
- natural gas,
- thermal energy,
- water,
- temperature,
- humidity.

To regulate the course of energy consumption, the system most often uses the regulation of the agreed four-hour maximum power output or the regulation of the agreed twenty-four-hour maximum amount of natural gas consumption.

System Max Communicar 9 options:

- Supervision and administration of consumption points (tens to hundreds),
- large number of meters at sampling points (up to one hundred and twenty meters),
- the system provides three levels of authorization,
- online monitoring of the current status of measurement and control,
- visual and audible warnings in case of major events,
- visualization of current measurement and control values directly in the technological diagram,
- remote control and parameter change,
- measurement archiving,
- compilation of consumption diagrams and reports,
- calculation of costs for energy consumption, including surcharges.

The energy consumption measurement values in Max Communicator are displayed using consumption diagrams. Sampling diagrams have different time interfaces.

The following table contains the types of consumption diagrams and their time options in Max Communicator 9.

Table 1 The types of consumption diagrams Max Communicator 9 (Kobert, 2014)

	Quarter hour	daily	Sifty	Monthly	Annual	Year-on-year
Measurement of electricity consumption	✓	✓	✗	✓	✓	✗
Individual measurements	✓	✓	✓	✓	✓	✓
Gas consumption measurement	✗	✓	✗	✓	✓	✗
Temperature measurement	✗	✓	✗	✓	✓	✗
Humidity measurement	✗	✓	✗	✓	✓	✗
Calculation of costs	✗	✗	✗	✓	✓	✗
Hourly diagram	✗	✗	✗	✓	✓	✗
Load duration curve	✗	✓	✗	✓	✓	✗

The table above shows that Max communicator 9 analyzes energy consumption most often on a daily, annual and monthly basis. The company uses data and data from reports to manage energy costs. It is necessary for the company to predict and forecast its costs in the future. Based on data from Max Communicator 9, the user receives the necessary data from a specific location. It is typical for mining companies to have more establishments, locations where they mine, and for each of these establishments it is necessary to monitor the energy costs and thus by summing the establishments to determine the energy consumption costs for the whole enterprise. Reports showing energy costs serve as a basis for the company's

pricing policy, for financial and economic analyzes and other internal analyzes of the company.

4. Conclusion

Monitoring costs in the company is important and desirable. Mining companies have energy costs around 15% of the company's total variable costs. Mining companies usually perform mining in several locations, so it is necessary to monitor the costs of individual establishments and the total costs of the company. This is also the case in terms of energy costs. One of the ways to optimally monitor the energy consumption of individual mining companies is the use of special software that measures, regulates and provides outputs of measured values through reports. The reports serve as a basis for users who continue to work with them. Data and data on energy consumption are an important parapet for the company's pricing policy but also for economic and financial analysis. The use of IT technologies and software for measuring energy consumption in quarries is desirable and is one of the forms of cost optimization in mining companies.

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INFORMATION SECURITY

Optimization of Bit Template in Authentication Problems

Elena Nyemkova[1], Morika Rusynko[2], Dmytro Kostyrko[3]

Abstract. The authentication of electronic devices on the physical level is possible using the parameters of their internal electromagnetic noise. The bit template is calculated from the autocorrelation function of the noise and uniquely characterizes each device. For personal computers, the template length is 1000 bits. Research has shown that it is possible to reduce the length of the bit template by 7.4% while keeping the probability of correct authentication.

Keywords: electronic device; correlogram; bit template; internal electric noise.

JEL Classification: C53

1. Principles of electronic devices authentication

Today it is difficult to imagine the work of almost any organization without computer networks and databases, and therefore, information security issues are becoming increasingly important. However, with the development of information technology, the level of cybercrime is also growing, and cybercriminals can become victims of commercial organizations or banks, as well as government agencies. That is why there is a need to protect against unauthorized access, from the seizure of confidential information, rights and privileges by intruders.

Unauthorized access becomes possible due to the imperfection of security systems: access control technologies, user identification and authentication processes. In this regard, the developments of new methods of ensuring security, as well as the improvement of existing ones are one of the most priority areas for the development of security systems.

[1] Lviv Polytechnic National University, Department of Information Technology Security, Bandery St., 12, Lviv, Ukraine, olena.a.niemkova@lpnu.ua.
[2] Lviv Polytechnic National University, Department of Information Technology Security, Bandery St., 12, Lviv, Ukraine, morika.k.rusynko@lpnu.ua.
[3] Ukrainian Academy of Printing, Department of Financial and Economic Security, Accounting and Auditing, Pidvalna St.,17, Lviv, Ukraine, kostyrkodm@gmail.com.

The first thing that both the user and the attacker face when accessing any service is authentication. It is this action that makes it possible to determine that the user who applies for information or wants to carry out some actions is the one for whom he claims to be. Without user authentication, it is impossible to authorize, that is, to grant certain rights. If an attacker can authorize on behalf of a user who has the necessary permissions in the target system, then he gets these access rights and his tasks will most likely be completed. The purpose of authentication is to make it as difficult as possible to use someone else's credentials. And although password authentication provides satisfactory protection in a number of tasks, this is far from the only verification option.

The authentication principle based on the password information (authentication by “what you know”) is used, which may include the physical address of electronic devices (MAC-addresses) or predefined certificates. The authentication by “what you have” isn’t used so often. Here radio-frequency identification tags (RFID-tags) are a typical example. A fundamentally different approach is based on the physical layer (authentication by properties), mainly using: Physically Unclonable Functions (PUF) for authentication of Internet of Things (IoT) schemes and on-chip instrumentation of internal group network (Scholz et al, 2020), the error of vector trajectory of Global System for Mobile Communications (GSM) (Hasse et al, 2013) and Two Dimension (2D) Synchrosqueezing Transform (SST) (Baldini et al, 2018) for mobile telephones signals, as well as a certain spectrum of the electromagnetic noise signal from operating devices. The possibility of authenticating devices has been experimentally confirmed by the noise spectrum of electromagnetic radiation, which spreads both through cables (Svoboda and Schanfein, 2012) and over the air from various types of devices: light-emitting diodes (LED) screens, mobile telephones, notebooks, and many others electronic devices (Chouchang and Alanson, 2016), wireless fidelity (Wi-Fi) transmitters (Wang et al, 2019), ZigBee wireless modules (Bihl et al, 2016). Also, a specific noise spectrum was used for audio forensics tasks.

All electronic devices cause some electromagnetic interference (EMI). Normally, engineers try to reduce the EMI level as well as possible, but typically, the signal cannot be completely suppressed. The idea of using EMI to authenticate devices is very attractive because no additional modules are

required to generate an authentication signal. EMI should be measured inside the device. This could be applied to many electronic devices that are currently in use. The advantages of this approach are as follows: a significant reduction in the influence of the electromagnetic background; elimination of a systematic error caused by an external meter; unlimited device mobility to the location of a third-party meter. Experience shows (Nyemkova et al, 2018) that there is reproducibility / long-term stability of the noise autocorrelation function, but small changes are happening for intra and inter identification metrics for devices. Usually, Hamming distance is used as such metrics: intra Hamming distance (Hamming distance among repeatability measured device identification) and inter Hamming distance (Hamming distance among different devices identification).

Assessment of authentication errors depends on the methodology for measuring electrical interference - noise, as well as on the method of extracting authentication signs from noise. Comprehensive information about the individual characteristics of a device can be obtained from noise measurements using the embedded ADC, for example, in the case of a personal computer using the ADC sound card. In this case, the influence of the electromagnetic background of the environment is minimized. Therefore, it could be expected that authentication errors will be less when using internal electrical noise. Note that this method can also be used to improve the accuracy of the authentication of wireless devices.

Authentication by individual features occurs when comparing templates, one of which is in the database (standard) and is calculated when setting up the authentication system. The second template is current and it is calculated from current measurements. To authenticate the object, it is necessary to compare the standard with the current template, i.e. to extract the standard template from the database and to make a comparison. All this takes time, and the longer the template, the more time will be spent. This is especially true for large systems, where many PCs "want to authenticate" almost simultaneously. Therefore, the task of reducing the length of the template, if possible, is extremely important.

The purpose of this study is to establish the possibility of reducing the length of the bit template noise of an electronic device on the example of

personal computers while maintaining inter- and intra-Hamming distances between templates.

2. Experimental equipment and results

The experiments have been performed at 12 personal computers (PC) that are all from one batch (AMD A-series, case STM Soho 112, ATX, Mid Tower) with the operational system Windows, and contain sound card Realtek (Realtek High Definition Audio Drivers) with 16-bit ADC [9/24]. Before recording noise, a multimeter test was performed. All sound card recorders (such as microphones, line-in), except for the mixer, were turned off using the sound control panel on the computer.

There was used sampling frequency of 44.1 kHz during the measuring. For stationary PC the level of internal electrical noise was ≈200 μV. Thermal noise for the frequency range from 20 Hz to 20 kHz in the measuring schemes has a constant spectral density and can be estimated as 6 μV, therefore, its influence can be neglected.

It was found that the noise oscillograms of the left and right ADC channels are statistically independent, for further calculations the results of noise measurements of the left channel were used. The waveform plot is modulating white noise. Typically, for the first several thousand samples of the oscillograms, noise stabilization processes took place. In further calculations, this part of the records was excluded. Then the oscillogram's characteristics were calculated: average values of amplitudes $m(x)$, variance $var(x)$, kurtosis, and skewness. A comparison of the noise amplitudes distribution with the Gaussian process illustrates that beginning from the recording duration of 0.5 s the noise could be assumed as stationary.

The normalized autocorrelation function (ACF) of noise for N samples x_i was calculated as

$$a_k(x,x) = \frac{1}{\mathrm{var}(x)(N+1)} \sum_{i=1}^{N} (x_{k+i} - m(x))(x_i - m(x)) \qquad (2)$$

For ACF there were discovered the following:

–the uniqueness of the noise signal of correlogram's detailed form for each PC (increasing or decreasing of the next value normalized ACF comparing with the previous), Fig. 1,

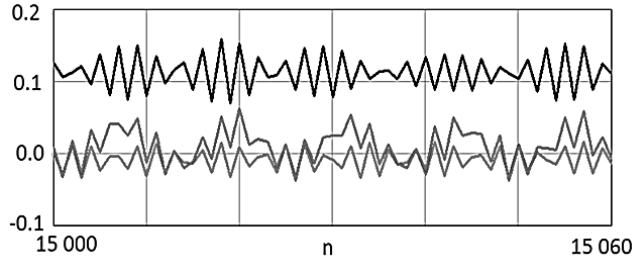

Figure 9 Fragments of noise correlograms, recorded during different time moments from the three different stationary computers

–the correlogram of the noise signal for each PC has an almost unchangeable detail form for different record files, Fig. 2,

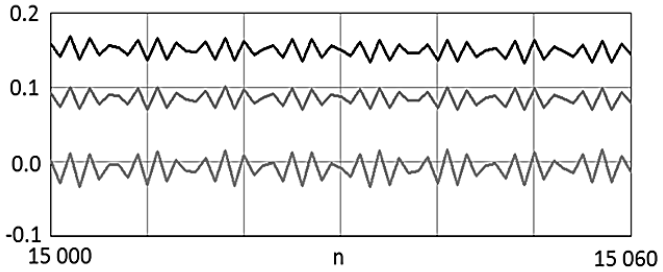

Figure 10 Fragments of noise correlograms, recorded during different time moments from the one stationary computer

For the description of the correlogram's detailed form, a bit template has been proposed – binary code, that characterizes the increase or decrease of the normalized value ACF $\{a_n\}$ for two consecutive lag values n and $n+1$

$$B^I{}_n = \begin{cases} 1, a_{n+1} \geq a_n \\ 0, a_{n+1} < a_n \end{cases} \quad (2)$$

For comparing pair of bit templates the Hamming distance was used. Comparison of Hamming distance for bit templates calculated from normalized ACFs of noise signals, which were recorded from two computers and one computer, showed enough length of 1000 bit template for performing computer authentication. According to identification results (one to many)

12 PC, all of them were trustily identified except the one PC, which has been identified as another one.

3. Analysis of Obtained Results

The next step is to find common values in the average bit templates for all PCs. That is, if a certain bit position will have a value that coincides with other values at the same position in all bit templates, then it can remove this bit from consideration.

The main task of the study is to find the possibility of optimizing the length of the bit template. Of course, if the template is too long, it causes inconvenience when writing and deleting from the database, because there is a limit on the length of the binary variable in the database. Therefore, it is desirable to reduce the length of the template, because the smaller the amount of information that needs to be saved and then removed from the database for comparison, the faster the authentication process and, clearly, easier to work with such information.

The positions of the bit patterns *j* were defined, which contain the same bit values for all patterns. Following the calculation results, 74 positions coincided for the template with a length of 1000 bits. Additional research has shown that the positions of the matching bits are independent of the length of the noise record, which is used to calculate the autocorrelation function. For PCs of one batch, these positions can be considered a group identification feature of this batch, Fig. 3. For PCs of other batch, these positions turned out to be different.

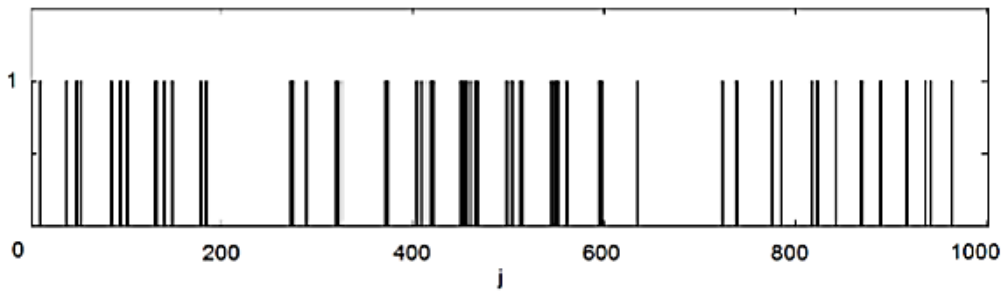

Figure 11 The same bits positions of the studied templates

Next, the average templates were compressed by deleting the found positions with the same values of *j* bit sequences. As a result, each template

was reduced to 926 bits. The next step was to calculate the Hamming distances between the optimized average templates and the corresponding current bit templates (intra-Hamming distances), as well as the Hamming distances between the various average templates (inter-Hamming distances). Calculations showed that the intra-Hamming distances decreased insignificantly, while the inter-Hamming distances remained at the previous level, Fig. 4.

H11 =

	1	2	3	4	5	6	7	8	9	10	11	12
1	0	470	449	440	439	437	444	516	550	440	445	441
2	470	0	327	330	325	325	358	506	480	330	333	325
3	449	327	0	89	106	104	119	505	429	79	94	102
4	440	330	89	0	39	37	88	508	432	48	63	41
5	439	325	106	39	0	6	87	507	429	41	52	12
6	437	325	104	37	6	0	87	507	431	37	50	12
7	444	358	119	88	87	87	0	512	444	94	91	87
8	516	506	505	508	507	507	512	0	494	514	505	503
9	550	480	429	432	429	431	444	494	0	426	437	431
10	440	330	79	48	41	37	94	514	426	0	65	41
11	445	333	94	63	52	50	91	505	437	65	0	52
12	441	325	102	41	12	12	87	503	431	41	52	0

Figure 12 Matrix of inter-Hamming distances for optimized / non-optimized average templates

The equality of matrices of inter-Hamming distances for optimized/non-optimized average templates proves the accuracy of the calculations.

4. Conclusion

For a set of PCs of one batch, it was possible to reduce the length of the average bit template by 7.4% by eliminating positions with the same bits. This will reduce the time it takes to authenticate an electronic device (PC) by speeding up the procedures associated with retrieving templates from the server database.

As a result of the optimization of the templates, the existence of a group individual feature for a PC of one batch, namely a set of indices with the same bit values, was revealed. The value of the indices of the same bits does not change with an increase in the length of the autocorrelation function.

The authors suggest further development of the research subject in the application of the method to a wider range of devices, namely smart sensors

and devices of the Internet of Things, the most part of which have embedded ADC and microprocessors.

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Principles of Creation a Cyber Attack Response Plan

Jan Ministr[1]

Abstract. Protecting of IT in organizations has been never important. In order for an organization to successfully face cyber attacks, it must have a defense plan in place to respond to those attacks. Such a plan must not only be continuously updated, but also practiced at all levels of the organization.
The article deals with principles of creating a cyber attack response plan which is necessary to ensure cybersecurity throughout the organization.

Keywords: Cybersecurity, Endpoint, Management Treat Response Service.

JEL Classification: M15

1 Introduction

The ITIL and Cobit methodological frameworks provide general information for creating an organization's cybersecurity system, which is often underestimated. But often only after a specific attack does the organization's management realize that it could have avoided large losses if there was an effective and effective incident response plan in the organization (Franke, 2016). The ensuring of cyber security is now increasingly costly for organizations. Malware threats are becoming more complex. According of (Sophos, 2018) study the 87% of IT managers agree that organizations lose an average of seven working days per month identifying and repairing infected computers (Sophos, 2020). Only 16% of information security executives today are able to collect, analyze, and respond to 75% or more of their telemetry security events today (Forbes.com, 2019).

The practical experience of cybersecurity companies leads to the creation of frameworks for planning the response to cyber security incidents, which increase the chances of thwarting the attacker's unfair activities (Caravelli & Jones, 2019; Diogenes & Ozkala, 2019).

[1] VSB - Technical University of Ostrava, Department of applied informatics, 17. Listopadu 2172/15, 708 00 Ostrava-Poruba, jan.ministr@vsb.cz.

The creation of the Cybersecurity incident response plan can be divided gradually into several steps (see Fig. 1), which are described in more detail below.

2 Cyber Attack Response Plan

Most methodological frameworks present several steps of creating a cyber attack response plan, which are based on methodological frameworks of fthe IS life cycle (ITIL, Cobit, Togaf, etc.). Therefore, the following cyber attack response plan steps can be identified.

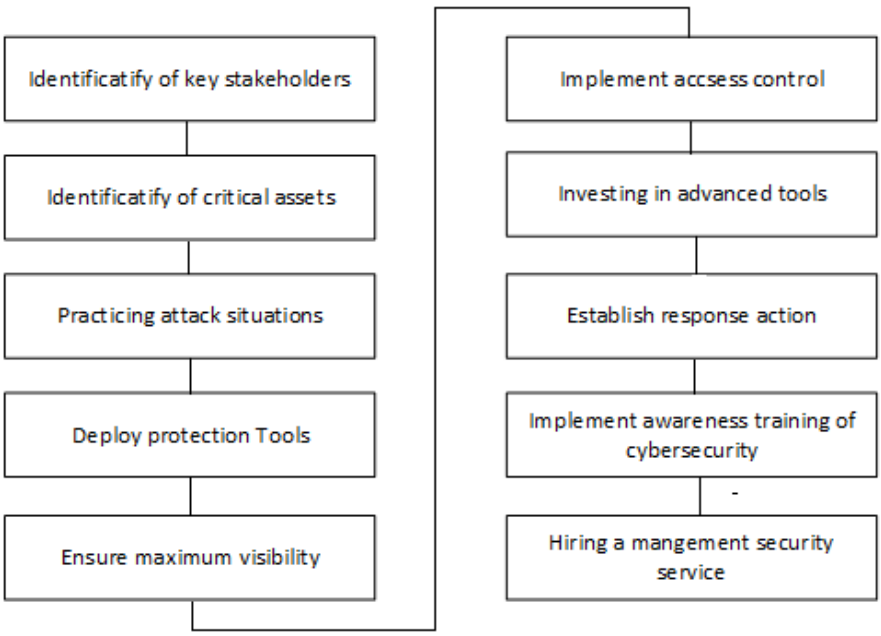

Figure 13 Cyber Attack response plan steps, Source: according Sophos, 2020.

2.1 Identification of the key stakeholders

Management of organization is responsibly, because an incident will likely impact almost every department in your organization, especially if the incident turns into a full-scale breach. For a correct and coordinated response, it is first necessary to determine who is to be involved

in this response. This should take into account the possibility that your normal channels of communication (i.e. corporate email) may be impacted by an incident.

These situations also need to be practiced in order to ensure a way of communication in advance that ensures a rapid response of the attacked organization, when common communication channels can be attacked (i.e. email).

2.2 Identify of critical assets

To determine the extent and impact of an attack, the attacked organization must first identify the highest priority assets. Mapping the highest priority assets not only helps determine the protection strategy, but also makes it much easier to determine the extent and impact of the attack.

In addition, if assets are identified in advance, the incident response team will be able to focus on the most critical assets during the attack, thus minimizing business disruption.

2.3 Practicing attack situations

Practicing of cyber attack, resp. emergency response has its pitfalls. It is relatively difficult to fully replicate the intense pressure that a team experiences during a potential disruption; practical exercises will ensure a more coordinated and effective response when a real situation arises. It is important not only to conduct technical exercises together with broader exercises that include the various previously identified business stakeholders. Practicing cyber attacks should test the reactions organizations on various potential incident response scenarios. Each of these scenarios may also involve stakeholders beyond the immediate technical team. The organization's management should determine in advance who must be informed when an attack is detected, even if it has been successfully defended (Danel et al, 2015).

Common incident response scenarios include:

- *Finding an active opponent*: In these scenarios, it is important for the response team to determine:
    - how the attacker was able to penetrate your environment,

- what tools and techniques he used,
- what he was targeting, and whether he demonstrated perseverance.

This information will help determine the correct course of action to neutralize the attack.

While it may seem obvious that the enemy needs to be expelled immediately, some security teams sometimes choose to wait and watch an attacker obtain important information to find out what they are trying to achieve and what methods they are using to achieve it.

- *Successful data breach*: If a successful data breach is found, the organization should be able to determine what and how it was filtered. This will then provide information on the right response, including the potential need to assess compliance impacts, if customers need to be contacted, and potential legal or enforcement involvement.
- *Successful ransomware attack*: If critical data and systems are encrypted, the organization should follow a plan to recover those losses as quickly as possible. This should include the process of restoring systems from backups. To ensure that the attack does not recur once the organization rejoins, it should examine whether the enemy's access has been interrupted. In addition, a larger organization should determine whether it would be willing to pay a ransom in extreme situations and, if so, how much it would be willing to spend.
- Threat to a high-priority system: the organization may not be able to do business normally. In addition to all the steps required as part of an organization's incident response plan, also consider creating a business recovery plan to ensure minimal disruption and loss.

2.4 Deploy protection tools

The best way to deal with an incident is to protect it from it with quality and effective protection. The organization must have adequate protection for endpoints, networks, servers, clouds, mobile devices, and e-mail (Ministr et al, 2020).

2.5 Ensure maximum visibility

In order for an organization to respond appropriately to a cyber attack, it must have a proper overview of what is happening during the attack. Before an attack occurs, the organization of the relevant IT security teams should verify that they have the ability to understand the extent and impact of the attack, including the determination of entry points and persistence points. Proper visibility involves collecting log data with a focus on the endpoint and network data (Sophos, 2018).

Because many attacks take days or weeks to detect, it is important that you have historical data dating back several days or weeks (even months) to investigate. In addition, it is necessary to verify that this data is backed up so that it can be accessed during an active incident.

2.6 Implement access control

Attackers can use weak access control to penetrate an organization's defenses and escalate privileges. Therefore, it is necessary to regularly make sure that the correct controls are in place to implement access control. This includes, but is not limited to:

- deploying multifactor authentication,
- limiting administrator privileges to as few accounts as possible (in accordance with the least-privileged people principle),
- changing default passwords,
- reducing the number of access points to monitor.

2.7 Investing in advanced tools

In addition to providing the necessary visibility, the organization needs to invest in tools that provide the necessary context during the investigation. The most common tools used in incident response include:

- *Endpoint Detection and Response* (EDR), which helps analysts identify which assets have been compromised, making it easier to determine the impact and extent of an attack (Nyemkova et al, 2020). The more data is collected - from and outside the endpoints, the easier it is to determine what the attackers targeted, but also how

they gained access to the environment and whether they still have access to it (Beley & Chaplyha, 2017).

- *Extended Detection and Response* (XDR), which allows you to hunt in your environment to detect *Indicators of Compromise* (IOC) and *Indicators of Attack* (IOA).

In addition to EDR tools, advanced security teams can deploy *Security Orchestration, Automation, and Response* (SOAR) solutions to assist in response workflows.

2.8 Establish response action

Detecting an attack is only part of the process of eliminating it. In order for an organization's security teams to respond properly to an attack, they must ensure that they are able to take a wide range of remedial action that would disrupt and neutralize the attacker. Response actions include, but are not limited to:

- Isolating affected hosts,
- Blocking malicious files, processes, and programs,
- Blocking *Command and Control* (C2) and malicious website activity
- Freezing compromised accounts and cutting off access to attackers
- Cleaning up adversary artifacts and tools
- Closing entry points and areas of persistence leveraged by attackers (internal and third-party)
- Adjusting configurations (threat policies, enabling endpoint security and EDR on unprotected devices, adjusting exclusions, etc. (Sophos, 2019)
- Restoring impacted assets via offline backups

2.9 Implement awareness training of cybersecurity

While no training program will ever be 100% effective against a determined opponent, training programs (ie, phishing awareness) will help an organization reduce the level of risk and limit the number of alerts that the organization must respond to.

Using tools to simulate phishing attacks provides an organization's employees with a safe way to experience (and potentially fall victim to) phishing, register those who fail training, and identify at-risk user groups that may require additional training.

2.10 Hiring a management security service

Many organizations are not able to manage incidents on their own. Fast and efficient response requires experienced security operators. Ensuring the correct response then requires working with an external provider of this service, such as a *Managed Detection and Response* (MDR) providers which offer.

- Continuous threat hunting, investigation and incident response provided as a managed service.
- Help organization respond to incidents before they become a violation,
- Primarily helps reduce the likelihood of an incident. MDR services are becoming very popular: according to Gartner *, 50% of organizations will use MDR services by 2025 - less than 5% in 2019 (Forbes.com, 2018).
- *Data Forensic Incident Response* (DFIR) services are also occasionally maintained after an incident to gather evidence to support a legal or insurance claim (Maksymovych et al, 2019).

3 Conclusion

When a cyber security incident occurs, the time it takes to eliminate it is crucial. A well-prepared and well-understood Cyber Attack Response Plan, which all key parties are able to implement immediately, will dramatically reduce the impact of the attack on the organization.

Every organization should consider whether it is able not only to create such a plan, but also to fulfill it on its own. Cooperation with external managed detection and response providers seems to be a suitable solution to this situation. In addition, these providers provide these services comprehensively and practice recommends focusing on one provider.

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Informative Safety as Constituent of Economic Safety of Enterprises

Nataliia Zelisko[1]

Abstract. The article is analyzed and identified main threats to the information and communication system enterprises and their impact on the enterprise. The definition of information security is given enterprises. In the course of the study, the author found that the system ensuring the economic security of the enterprise is based on based on basic principles: systematization, automation, development, continuity, openness to interaction with other systems, scaling, legality, and special principles: combination publicity and confidentiality, competences, economy, interaction, planning, adaptability, timeliness and others

Keywords: economic security, information security, information technology, information systems, information protection.

JEL Classification: D830

1 Introduction

In the modern terms of manage stands especially sharply question of ground of defense of economic interests of the Ukrainian enterprises, and also accepted strategic decisions. Eurointegration processes pull out the row of requirements to the enterprises of Ukraine, that force to adapt oneself to the increase of level to the competition and to search the adequate decisions of the most thorny problems and ways of decline of the threats of the activity, predefined by a conflict, vagueness and risks. Unfortunately, modern scientific economic researches of activity of national enterprises do not give an integral idea about safety of activity to business. In particular, practically absent idea about character functioning of the system in an aggressive environment and providing of economic security of enterprise is in the conditions of globalization to business on the whole. In present terms a manage appears problem of providing of economic security of enterprises as an economy growing of national depends on her decision.

[1]Lviv National Agrarian University, department of Ekonomy, 1, Volodymyra Velykogo st., Dubl'iny, 80381, Ukraine, zeliskon@ukr.net.

2 Ensuring the economic security of the enterprise

The purpose of ensuring the economic security of the enterprise should be the system counteracting potential and real threats, the development of preventive measures to eliminate or minimize which should to ensure the success of the business entity in unstable external and internal conditions environment. Thus safety of the enterprise should be provided in such basic directions, as economic, scientific and technical, information, personnel, social, ecological, physical security, etc. The breakthrough of information technology in the late twentieth century. At the beginning of the XXI century, it caused significant systemic transformations in the world, which made it possible to form and develop fundamentally new and integral global substances information space and information society. Uncontrolled distribution and unrestricted use of information space by the world's leading countries as an arena of action in. The process of modern information confrontation has gradually led to the vulnerability of the information sphere of these countries to influence internal and external cyber interventions and threats of intentional, accidental, natural or artificial nature [2]. At the same time, the dependence of the general becomes more and more obvious level of economic security of the state and enterprises from its information component.

3 Features of information provision of the system of economic security of the enterprise

Under such conditions, the organization of information support activities of business entities should be comprehensive nature and be carried out in various areas of information environment. In addition, information support should meet the following requirements:

- legality – to be carried out within the current legislation;
- continuity – information resources to ensure their high quality must be constantly updated;
- activities – forces involved in information security, must constantly strive to obtain information;

- high technical equipment – information work should be based on modern computer tools and technologies collection and processing of information;
- competencies – persons who perform tasks information support, should be professionals, table to perform their duties at a high level.
- The information needs of most businesses are approx the same. Therefore, the main requirements for information are as follows:
- significance – influences decision-making, useful for users at the right time when making plans;
- reliability – truthfully presented information, easy is checked and has a neutral character;
- completeness – contains the maximum of what you need to know interested parties and includes all necessary comments;
- relevance – related to the actions that involve obtaining the desired results (for this you need to know the scope use of information and its source);
- no systematic errors – suggests disinterested identification and transmission of information, as well as the use of techniques and methods that exclude making systematic mistakes.

4 Conclusion

As a result, we can formulate the value information in the system of economic security of the enterprise:

1. . Information is an integral part of doing business and necessary to support all aspects of economic security enterprise security.
2. Information is a strategic general business resource, which is subject to legal and directive requirements.
3. The information is protected and accessible to the public in accordance with legal and policy requirements.
4. High quality information is very important for success conducting economic activity of the enterprise.

5. Information management is the responsibility of managers each structural unit of the enterprise.

Thus, the importance of information in the security system economic security is determined by the need to ensure effective management decisions, effective development and implementation of investment projects of the enterprise, increase the level of overall competitiveness that can be carried out on the basis of optimal input and output information flows and flows within the enterprise.

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DIGITALIZATION IN PANDEMIC CONDITION

Risk Management and IT Risk Management Processes and Implementation

How Covid-19 has changed them

Milos Maryska[1], Lea Nedomova[2], Petr Doucek[3]

Abstract. This paper is devoted to the one of the most important part of daily life in all companies, especially in current Covid-19 time. This part is Risk Management. Paper is describing Risk Management discipline itself with focus on the risk in the area of Information Technology (IT). We analyzed key processes, factors and risks and best practices, which have to be considered into account when IT risk management is introduced into company during Implementation project. This paper does not describe any technology supporting risk management.

Keywords: Risk Management, Information Technology, Risk Process, Operation Risks, Best Practice.

JEL Classification: G32; D8

1 Introduction

Risk Management as a discipline and a company process should be an important part of every company, and every company should pay attention to Risk Management to a different degree of detail and frequency.

The importance of risk management keeps growing especially now during the Covid-19 crisis, and companies that have not yet focused on this area are beginning to focus on it or are continuing to deepen its importance. As an example of an external pressure on the functioning of risk management, we can use the Czech National Bank that regularly asks financial institutions about their risk management methods and ways of responding to the current Covid-19 crisis.

A separate category of risks are risks that are based on the theory of chaos, the theory of black swan and similar theories and cannot be predicted (Babei, 2013; Kiel and Elliot, 1996; Taleb, 2010; Hammond, 2009).

[1] Prague University of Economics and Business/Faculty of Informatics and Statistics, Department of Information Technology, W. Churchill sq. 4 Praha 3, maryskam@vse.cz
[2] Prague University of Economics and Business/Faculty of Informatics and Statistics, Department of System Analysis, W. Churchill sq. 4 Praha 3, nedomova@vse.cz
[3] Prague University of Economics and Business/Faculty of Informatics and Statistics, Department of System Analysis, W. Churchill sq. 4 Praha 3, doucek@vse.cz

Based on its basic definition, risk management is the process of identifying, analyzing and responding to risk factors that are a part of a company's life (ISO 31000). Its effectiveness is considered a very important part of risk management. Effective risk management is considered to be a situation where risk management achieves maximum control over future outcomes through proactive activities (CFI, 2020; Laurens, 2012). The essence of effective risk management is to reduce the possibility/probability of risk and its potential impact (CFI, 2020).

Some of the main standards that address this issue are e.g. ISO 3100 Risk Management Principles and Guidelines that were issued in 2009 and Basel III that was issued in 2010 and was to be implemented in 2015 at the latest (Deloitte, 2020). Due to repeated delays, its current mandatory implementation is scheduled for 1 January 2021. Another standard, which focuses on IT only, is e.g. the Cobit standard that tackles risk management in IT (ISACA, 2012). It is very interesting that ISO 31000 was adopted in 2015 by 57 countries (including the USA) as the basic national standard for risk management (ISO 31000).

The aim of this article is to describe the basic parameters of risk management both in general and in the area of information technologies and to analyze the key criteria that must be considered during the actual implementation of Risk Management processes in a company.

2 Risk Management

Risk management is an important process in every company. Risk management is a system of tools that help companies identify and respond (deal with) the risks identified by individual owners of company processes and risks as part of risk management processes.

The basic premise of good-quality risk management is adherence to the rule: every risk must be recorded and properly assessed at the moment of its identification.

Progressive risk management ensures that high priority risks are handled as aggressively as possible. In such a case, company management will have the necessary information to make informed decisions and to ensure that the company remains profitable.

Risk management, as defined above, covers a variety of areas. The main areas include e.g. (ISO 31000; Deloitte, 2020; ISACA, 2012; McKinse, 2011; Svata, 2011):

- Strategic risks;
- Operational risks;
- Force majeure risks – incidental risks that cannot be prevented (armed conflicts, wars, natural disasters and other risks);
- Economic risks (market, trade-political, exchange rate and many other risks);
- Project risks;
- Environmental risks.

It is important to mention that individual areas may intertwine, where e.g. an operational risk may be caused by a force majeure risk and a strategic by an economic risk, etc. The classification of risks is thus ambiguous, and every risk manager/owner may perceive them in a slightly different context and as a slightly different type.

Whatever the area of risk or the area of their intersection, it is always necessary to clearly define the personnel aspect in risk management. Personnel aspect means the roles that are part of the risk management process. Personnel roles can be e.g.:

- The Board of Directors that bears the overall responsibility for the implementation and compliance with risk management in the given company;
- Risk owner who sets up and evaluates control mechanisms in the area of his responsibility. He is required to evaluate the effectiveness of the set controls and to decide about a potential implementation of additional control mechanisms in order to reduce any residual risk;
- Risk manager;
- Etc.

3 Implementation of the Risk Management System

Factors and risk management areas

The following main factors have an impact on the implementation of risk management in a company:

- Analysis, monitoring and management of operational risks;
- Assessment of operational risks and implementation of controls;
- Administration of operational risks and controls;
- Risk reporting and life cycle;
- Reporting;
- Dashboards for department managers and risk managers.

The setup of the actual risk management system provides the basis for its implementation. The system can be described e.g. by the following figure:

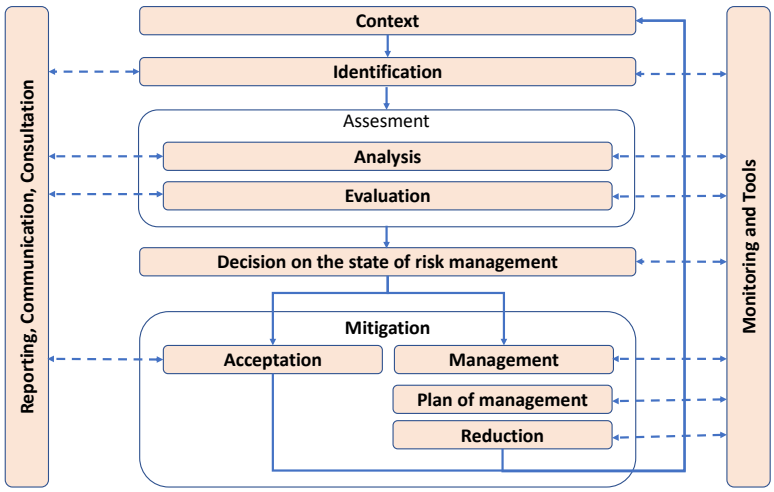

Figure 14 Flow diagram of quality risk management process, Source: QRM, 2005.

This figure is applicable to any group of risks, e.g. IT risks, financial risks and other risks.

Risk context is a process that defines a broader context of risks, in particular their categorization, and the process, the risks of which we manage. A correct risk context design will help to better understand risks, to provide presentation options that can be defined in a better and simpler way and, last but not least, to simplify the paperwork with risks, especially to facilitate risk assessment for owners and officers in charge of active risk management.

The risk owner/risk officer will provide the following assessment information for every identified risk:

- Comprehensive information for risk identification;

- Comprehensive information about measures/controls for individual risks;
- Confirmation of risk ownership;
- Confirmation of measure ownership;
- Assessment of measure effectiveness;
- Assessment of residual risk.

Every risk owner is responsible for identifying and managing operational risks related to the activity of the department of which he is in charge. It is also important to keep in mind that a risk is not only a threat but also an opportunity for growth.

Risk assessment has clear rules, is carried out by a risk officer in cooperation with the Risk Owner and includes the determination of frequency (Frequency) and the level of severity (Severity).

Risk mitigation is an integral part of risk management. The Risk Owner chooses the basic tactics of risk mitigation, ensures the implementation of appropriate measures to reduce or completely eliminate risks, continuously monitors the effectiveness of the implemented measures and adopts new measures.

Risk monitoring is based on continuous regular operational monitoring of risks, the assessment of risk management measures and the control of the implementation of adopted measures.

This process can be simplified and shown in a more traditional way, which is described in five steps: Identification -> Assessment -> Response -> Solution -> Control.

Risk management processes

Risk management processes in every company have basic common dimensions. These dimensions are the basic aspects of every risk that are monitored and subsequently managed. Such common dimensions include e.g.:

- Operation Risk Category;
- Financial Statement Area;
- Main Processes.

Each of the above dimensions can be further detailed into individual categories and subcategories assigned to individual risks.

For instance, the result of the detailing of the Operational Risk Category for Information Technologies are the following categories:

- Business Disruption Risk;
- Know-how Concentration Risk;
- Insufficient Human Resources;
- Hardware and Infrastructure Risk;
- IT Software and Security Risk;
- Model and Data Quality Risk;
- IT Development Risk;
- Project Risk;
- Process and Organization Risk;
- Cyber Risks;
- Legal risks;
- Human Error;
- People, labor productivity and resource planning;
- Lack of documentation.

In the case of the financial dimension for IT, the following categories may be important:

- Investment of IT unit;
- Investments Total;
- Operation expenses;
- Depreciation;
- Etc.

In the case of the last-mentioned dimension, i.e. Main Processes, it is important to define key processes in risk management. From the IT point of view, e.g. the following can be considered to be key processes:

- Product development;
- Product management;
- Change policy;
- Planning process;
- IT asset Management;
- Performance Management;

- Quality management;
- Human Resources;
- Procurement;
- Etc.

Risk assessment

The risk assessment in IT is similar to that in any other non-IT part of a company or a non-IT company. The so-called heat map, which looks at risks from two main perspectives, namely Severity and Frequency, is the most common assessment method. The following figure shows the typical heat map.

		Severity					
		Insignificant	Minor	Small	Moderate	Large	Severe
Frequency	Rare	Low	Low	Low	Low	Medium	High
	Occasional	Low	Low	Low	Medium	High	Very high
	Sometimes	Low	Low	Low	Medium	High	Very high
	Often	Low	Low	Medium	High	Very high	Very high
	Frequent	Low	Medium	High	Very high	Very high	Very high

Figure 15 Overall Risk Table (based on ISO/IEC 27005)

Risk catalog and risk card

The last key part of risk management includes a risk card and a risk catalog.

The risk card defines a set of items common for all risk categories. The risk card is the most detailed description of each risk and represents full structured information about the given risk. The risk catalog is a set of individual risk cards.

The risk catalog is a standardized list of risks monitored in a company. The risk catalog is a living document that must be constantly updated. The following basic attributes can be monitored in the risk catalog:

- Risk name;
- Categories and subcategories;
- Processes and subprocesses;
- Standard controls or measures;
- …Other attributes.

These attributes are taken from individual risk cards.

4 Conclusion

Risk assessment and management are the best way to prepare a company for any potential event that may hinder its progress and growth. Any company, which evaluates its plan to manage potential threats and creates structures that make it possible to handle such threats, will increase its chances to succeed. of becoming a successful entity.

The following rules can be considered Best Practice in the context of IT Risk Management:

- Evaluate often - there is no right time to start risk management processes, start immediately;
- Manage from the top: the pressure on risk management and motivation must come from the top;
- Communicate: there must be a clear flow of information about risks and their occurrence; this follows up on the next rule;
- Implement strong policies: the risk management process, roles and responsibilities must be defined;
- Involve stakeholders: all parties involved in the implementation of risk management should also be involved in the risk management process.

The current situation with the global Covid-19 pandemic provides a very interesting example. During the first wave in the spring, companies closed their operations and offices because no one knew what could happen. A large number of companies, including financial institutions, subsequently reviewed their risk catalog and expanded it for risks associated with the pandemic plan. As a result, a large number of companies did not close their operations during the second wave in the fall (e.g. the entire automotive industry, i.e. the economic engine of the Czech Republic) and responded to the situation by implementing clear hygiene measures to protect their employees from the disease and the company from its partial or complete shutdown.

Another detailed perspective of what the spring wave of the Covid-19 pandemic achieved includes the fundamental change in the procedural, organizational and technical functioning of companies that switched to home office. For instance, VPN (Virtual Private Network) usually had no technical

capacity to allow almost 100% home office before the first crisis but their situation was completely different during the second wave.

The following very important rule usually applies: prevention based on risk management is cheaper and more effective in terms of both damage and capacity demands than handling a problem caused by a risk-related incident.

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The Role of E-Commerce During the Covid-19 Economic Crisis

Agnieszka Rzepka[1], Maria Kocot[2], Magdalena Maciaszczyk[3], Damian Kocot[4], Anna Sabat[5]

Abstract. Economic crises, like the one caused by the COVID-19 pandemic in 2020, are a characteristic feature of the economy. Although many industries collapsed, a dynamic development of the e-commerce sector could be observed. The purpose of this article is to analyze this phenomenon. The conclusions present a proprietary model of e-commerce during the coronavirus epidemic. Efforts have been made to demonstrate the possible long-term effects of the development of new sales model in future.
The included recommendations for companies and retailers suggest further intensification of e-commerce. The summary of the article concludes that, despite the economic crisis associated with the COVID-19 pandemic, the e-commerce industry is growing rapidly and its introduction could be an effective means of surviving the economic recession. Thus smart management of this sector of the economy is crucial. The success factor in this respect is to treat one's consumers as business partners.

Keywords: e-commerce, COVID-19, pandemic, consumer, economy.

JEL Classification: H12, M41

1 Introduction

The crisis caused by the epidemic of COVID -19 proved to be a catalyst for the e-commerce industry, which recorded a significant increase in turnover after the economy froze up and shopping centers closed.

[1] Lublin University of Technology, Faculty of Management, Department of Economics and Economic Management, Nadbystrzycka 38, 20-618, Lublin, Poland, a.rzepka@pollub.pl, ORCID - 0000-0003-4495-6066.

[2] University of Economics in Katowice, Department of Economic Informatics, Bogucicka 3, 40-228 Katowice, Poland, maria.kocot@ue.katowice.pl, ORCID - 0000-0001-5150-3765.

[3] Lublin University of Technology, Faculty of Management, Nadbystrzycka 38, 20-618 Lublin, Poland, m.maciaszczyk@pollub.pl, ORCID - 0000-0001-7225-4921.

[4] University of Economics in Katowice, Department of Economic Informatics, Bogucicka 3, 40-228 Katowice, Poland, damian.kocot@ue.katowice.pl, ORCID - 0000-0001-9240-857X.

[5] Academy of Finance and Business Vistula, Faculty of Business and International Relations, Management Institute, Stokłosy 3, 02-787, Warsaw, Poland, a.sabat@vistula.edu.pl, ORCID - 0000-0002-3311-3269.

The number of new online shoppers who have experienced the benefits of this form of shopping continues to grow. The dynamic growth in e-commerce sales shows that online sales work well in crisis situations such as the current one caused by the coronavirus pandemic.

The aim of the article is to describe the dynamic development of e-commerce during the COVID -19. In order to analyze this phenomenon, the article deals with the concept of e-commerce, followed by an overview of the current economic situation during COVID-19, to illustrate the situation of the e-commerce market during this period. The authors' considerations lead to a proprietary e-commerce model applicable during the coronavirus epidemic. Its analysis reveals its long-term effects.

2 Definition of e-commerce - theoretical framework

Although it is somewhat difficult to define the nature of e-commerce, e-commerce is understood as an activity that consists of selling products and services over the Internet.

E-commerce comprises the production, advertising, sale and distribution of products via ICT networks (Sławińska, 2008). However, it would be quite a simplification to associate e-commerce exclusively with online shops. The online shop is merely an e-commerce platform that functions as a B2C, B2B or in a mixed form. Such a platform offering a single product could be considered an online shop. However, it is generally accepted that more products (services are offered less frequently) are sold in such a shop (Chaffey, 2016).

In the literature on this subject, the concept of e-commerce is often equated with the concept of e-business. However, the scope of the term e-commerce remains narrower than that of e-business. In general, e-commerce covers all aspects of commercial transactions conducted using electronic equipment and software (Dobosz, 2012), such as telephone, fax, computer or TV other electronic devices.

Electronic commerce can be defined as a way in which a company uses technology and media to improve its image and competitiveness by optimizing internal processes in the corporate network and traditional distribution channels and by bringing products to market (see Fig. 1). (Banaszak et. al, 2011).

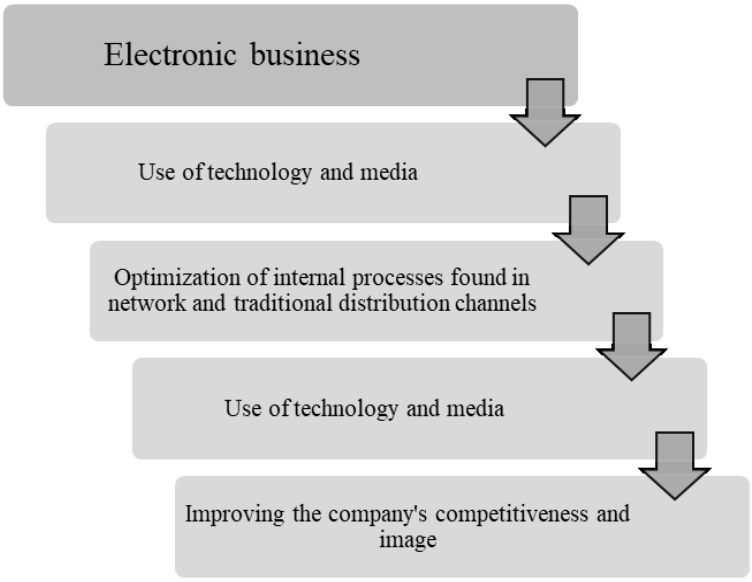

Figure. 1 Model of e-commerce, Source: own.

E-commerce can be divided according to the type of partners in a transaction. A distinction is made between the following systems (Trojanowski, 2010):

- business-to-business (B-to-B), which stands for transactions between companies and organizations,
- business-to-consumer (B-to-C), which stands for the retail sale of products to individual consumers
- business-to-public (B-to-P), which stands for the sale of products to public and government institutions and the mutual exchange of information necessary for the functioning of companies, public institutions and their potential customers.

Online product catalogues and online shops are part of virtual B-to-C commerce.

3 Economic crisis as a result of the COVID-19 pandemic

Again Pandemics represent one of the greatest potential negative global risks, especially in today's globalized world of increased integration between countries. They cause high morbidity and mortality and negative socio-economic impacts. The world is currently struggling with coronavirus disease

caused by SARS-CoV-2, which has already reached global pandemic status (Ghebreyesus, 2020).

The emergence of the epidemic has raised concerns about its negative impact on the global economy. It has been suggested that the new coronavirus will cause a prolonged global recession (Sirletti, Follain and Rotondi, 2020; Amaro, 2020). This suggests that the pandemic is affecting the economy in two ways. If we analyze demand, we can see a decline in consumer spending. People are falling ill or trying to isolate themselves at all costs. They would rather stay at home than travel or visit shopping centers, cinemas and museums.

Contrary to Keynes' convictions, lower demand should not be seen as the sole effect of the current pandemic. Certainly, a decline in demand will reduce GDP growth in the short term. However, spending should increase once the epidemic is over, especially since any economic shock is by definition short-lived. Lower consumer spending should not trigger an economic catastrophe, but should rebalance the economy with lower prices and a new structure of prices, production and consumption. Furthermore, we must not overlook the role of the government, which is prepared to intervene and increase spending on the broadly understood fight against epidemiological threats (Sieroń, 2020).

However, this impact becomes more pronounced in the case of the supply side of the economy, especially since epidemics significantly reduce the supply of labor. In most cases, however, this phenomenon is temporary due to the fact that some workers get sick or simply prefer to stay in quarantine rather than work (Ghebreyesus, 2020).

4 Changes in e-commerce

Restrictions on traditional ways of shopping and the need to comply with sanitary regimes have forced new consumer behaviour and the need to adapt to current conditions. Introducing social distancing has also contributed to a decline in traditional forms of shopping.

The last few months (April to June 2020) have become a period of growth in e-commerce. E-commerce is the result of restrictions imposed on traditional commerce. Consumers have shifted their activities to the virtual world, while the epidemic has undoubtedly changed their buying behaviour.

E-commerce has not lost its importance even while the economy is defrozen. Despite the gradual recovery of the economy, it is still unclear when it will return to full normality. Certainly, in the long term, all companies that have not introduced remote services will have to catch up quickly (ibid).

Despite the economic crisis, there are sectors that are developing dynamically. The e-grocery sector is registering growing interest from customers. For example, one of the biggest Polish online supermarkets, Frisco, due to its popularity, accepts orders at least one month in advance, whereas before the epidemic orders were delivered within 2-3 days at the most.

At present, the food technology sector is also valued. With the closure of the restaurant, companies offering a contactless and cashless form of food delivery began to operate. The manufacturers of protective equipment such as gloves, masks, antibacterial soaps or hand disinfectants are not keeping up with the production. These products are usually ordered online. The number of orders for over-the-counter medicines is also increasing, and the demand for courier services is growing. Data collected for "Rzeczpospolita" by Sendit, a company providing parcel delivery services, show that the demand for parcel delivery services has increased by about 20% more than its natural organic growth.

The phenomenon of social isolation has led to many aspects of life being transferred to the virtual world. According to PBI, 27.9 million Poles used the Internet in February 2020. In March this number rose to 28.6 million whilst in April the number of users was 28.2 million. Although a large part of Polish society has access to the Internet, it is used for various purposes (Badanie: Zachowania konsumenckie Polaków wobec pandemii COVID-19, 2020)

5 E-commerce during the coronavirus epidemic on a model basis

The above considerations have confirmed the rapid development of e-commerce and the growth of its role as a sales channel. This is primarily a consequence of the outbreak of COVID -19 and consumer concerns about their health and safety. As a result, consumers choose to shop online because of the lack of physical contact with the seller. Round-the-clock availability is not insignificant, as is the improvement in the quality of service provided by the company. Improvements in logistics are reflected in a growing number of delivery and payment methods. These reasons are reflected in the ability to make purchases without leaving home. Online shopping thus becomes a guarantee for the safety of customers' health.

The dynamic development of e-commerce leads to a number of phenomena:

- the creation of relationship systems between the e-consumer and the seller, and between the e-consumer and other e-consumers, which leads to a flow of information, knowledge and unique ideas,
- the tailoring of the offer to the needs of e-consumers on the basis of their feedback,
- raising awareness of the need to create positive experiences for buyers in their business contacts,
- taking measures that lead to the acquisition of valuable ideas and suggestions from the customer.

These phenomena are illustrated in Figure 2. They can lead to the development of a new sales model, which is implemented with the help of information technology. Despite the existence of various obstacles to the development of online trade, it is expected that it will expand rapidly in the coming years, even after the end of the pandemic. Particularly as the development of e-commerce can be considered one of the factors mitigating the economic crisis following the outbreak of the coronavirus epidemic.

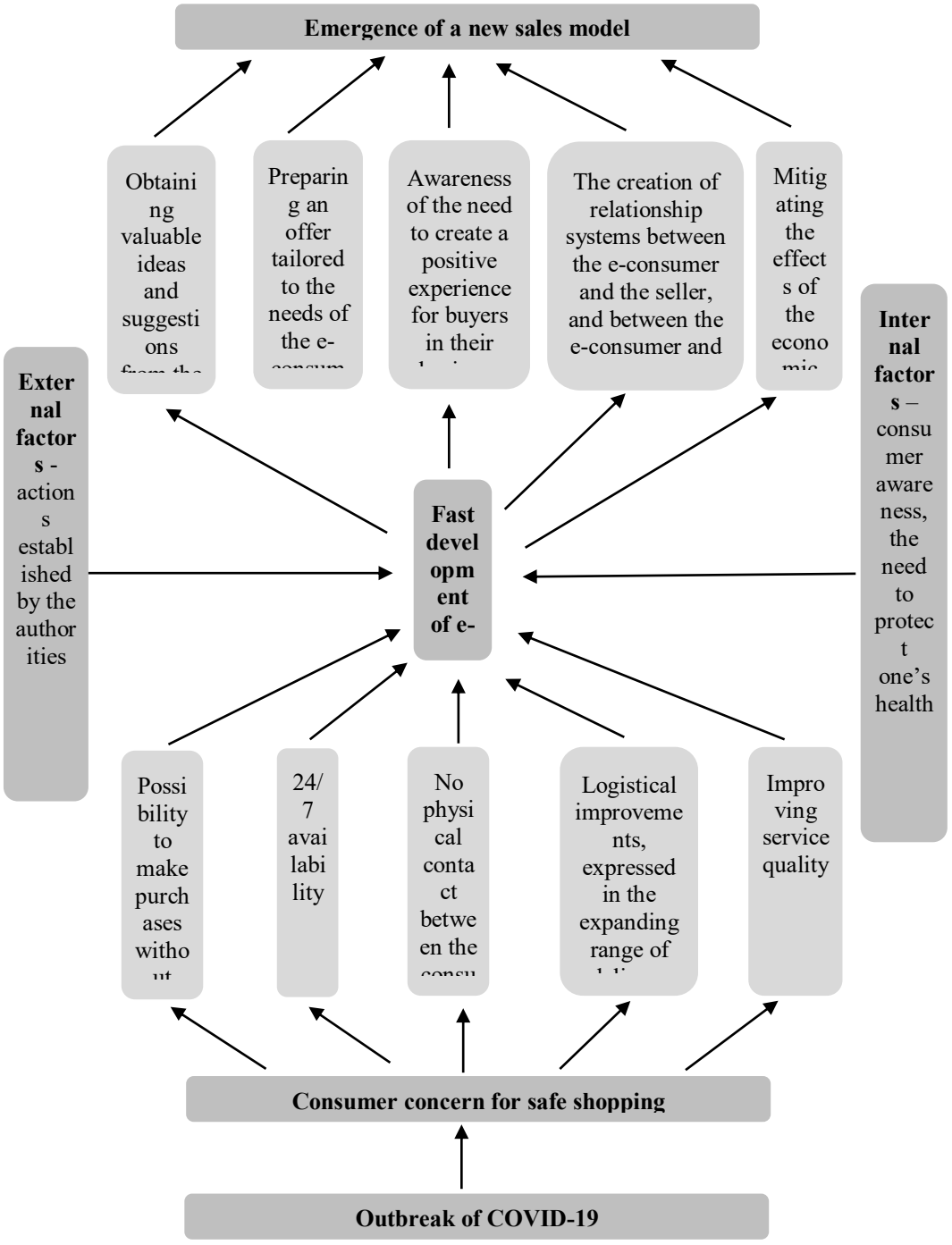

Figure 2. A model of e-commerce during the coronavirus epidemic, Source: own.

6 Conclusions

The new economic reality has forced consumers to change their behavior. At the moment, we are observing the emergence of a new model of consumer behavior that is determined by various conditions. The changes have brought about a structural approach to consumption and a growing importance of electronic commerce. In the process of social isolation, manufacturers and sellers communicate more actively with their customers via social media. Especially since the customers are often afraid to visit shopping centers due to the epidemic threat and therefore limit the frequency of their shopping sprees.

The COVID -19 epidemic has caused an economic recession. It has had a significant impact on the economy and trade. It has also significantly changed consumer habits, which are influenced by a number of external and internal factors. In recent months the consumer has become a health-conscious, socially isolated buyer. Increasingly, they have also begun to reap the benefits of electronic commerce. This phenomenon can lead to the development of a new sales model where the buyer receives the product according to his personal needs.

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New Digital Services in the Period of COVID–19 Pandemic in Domain of Public Administration in the Czech Republic

Jiří Slezák[1], Ivana Čermáková[2]

Abstract. The epidemic caused by disease COVID–19 in 2020 influenced life worldwide. Companies and private sector were closed during several weeks/months, public administration limited their own services and opening hours. Due to ongoing events, companies and public administration were forced to change the way of communication with a customer/citizen. The article focuses on the area of new digital services created during the COVID–19 epidemic for the communication of citizens as well as legal entities with public administration bodies. The aim of the article is to evaluate the possibilities provided by public administration for communication with citizens and companies, as well as to outline the weaknesses from the point of view of public administration and citizens and possible recommendations for further development of these services.

Keywords: COVID–19, Czech Republic, Digital Service, Smart Quarantine

JEL Classification: please select appropriate classification (predefined style "JEL")

1. Introduction

SARS–CoV–2 (COVID–19) is a highly infectious disease that appeared in Asia in late 2019 and has spread worldwide. Each state reacted differently to the problem. Some states have imposed a "lockdown" on their territory – a regulation where people (apart from strategically important professions – such as firefighters or paramedics) had to stay only in their homes and could go outside for vital needs, such as foodstuffs. Other states have had their people "soaked" to create collective immunity.

As for the Czech Republic, on which this article is focused, it went its own way. In the spring, the quarantine was first ordered, when people

[1] VSB - Technical University of Ostrava, Faculty of Economics, Department of Accounting and Taxes, Sokolská 33, Ostrava, 702 00, Czech Republic, jiri.slezak@vsb.cz
[2] VSB - Technical University of Ostrava, Faculty of Economics, Department of Applied and Informatics, Sokolská 33, Ostrava, 702 00, Czech Republic, ivana.cermakova@vsb.cz

were forced to work from home (home office), if their work allowed it. Many industries were closed, including school facilities that operated under distance learning. There were also restrictions on movement, especially in the number of people who could move outside and when it was necessary to protect the respiratory tract, either with masks or respirators. During the summer months, the situation was more relaxed, but in some areas the obligation to wear masks or respirators and to comply with other regulations remained.

In the autumn, the situation worsened again and there was a "soft lockdown", so companies and industries that are not strategically important were closed again, work from home was also ordered, if the scope of work allowed, school facilities were closed again and classes were taught in distance mode. Additional rules have also been set for the movement of people outside, including the reintroduction of wearing masks and respirators indoors (outside the residence) and more recently, in some outdoor areas such as public transport, buses and trains.

In connection with these measures, the public administration was forced to respond to the situation and provide services even in a difficult regime. Some authorities have already provided services in digital mode, for example through the Citizen's Portal or their own website, but most of the services provided by the public administration could not be used by ordinary citizens unless they had set up a data box or other platform to verify their identity. Thus, citizens using data boxes who already used digitized services before the COVID–19 epidemic continued to use these services, but other citizens were faced with deciding whether to set up a data box or other platform or to find another way to communicate with public authorities. Fortunately, some public authorities reacted to this and invented their own digitized services without the need to set up data boxes, etc. The aim of the article is to evaluate the possibilities provided by public administration for communication with citizens and companies, as well as outline weaknesses in terms of public administration and citizens.

The article also contains recommendations for further development and possibilities of application of digitization of services from the point of view of public administration bodies. The following chapter provides an overview

of the newly created digital services provided by the most used public authorities during the COVID–19 epidemic.

2. New Digital Services of Public Administration Bodies

Most public administrations have responded to the COVID–19 epidemic and introduced new digitized services, see below.

2.1. Ministry of Health

The project of the Ministry of Health is the Smart Quarantine system, which should lead to the timely capture and isolation of individuals who are potentially infected by the COVID–19 epidemic.

The smart quarantine procedure (ideally) is that if a person finds out that he or she has contracted COVID–19, he or she is contacted by an employee of the hygiene station, with whom he or she tries to identify all the contacts the person has come into contact with in the last few days. However, it often presents a problem. The problem is that the hygiene worker often does not call or call an infected person, but together they identify a minimum number of new contacts. In case of successful identification of new contacts, a commemorative map of all places where the infected person occurred is subsequently created. All reported contacts are also informed about isolation in a roughly five–day quarantine, during which they are visited by the sampling team and in case of finding that the quarantined person is positive, the mentioned procedure is repeated again (Ministerstvo zdravotnictví, 2020).

Part of the smart quarantine is the e–Rouška, which is a freely available application for smartphones, which should help to more easily search for contacts with whom people who have been diagnosed with COVID–19 have come into contact. The application collects data about meetings with other people who have this application downloaded to their smartphone (for example, time, proximity to people, etc.). In case that a person proves COVID–19, the application will notify this fact no later than the next day. The application does not inform about every meeting with a positively tested person, but only if, based on its algorithm, it evaluates that the meeting was risky. However, the condition is that the person infected with COVID–19

enters into the application a unique code received from the hygiene station. (e–Rouška, 2020)

However, the problem with the e–Rouška consists in a certain reluctance of citizens to download it. This application has more than 1 000 000 downloads, which is not enough for its optimal functioning. Reasons why people do not want to download the application include, for example, fear of losing privacy, they do not believe the fact that COVID–19 exists or is such a serious illness, or distrust of the government, etc. The problem is that people who are tested positively, do not enter the unique code mentioned in the application. However, public authorities are working to increase the number of uses of the application, for example in cooperation with mobile operators who send SMS prompts to install the application. Similar applications, which are used by other countries, are in some cases globally connected. (Idnes, 2020)

The virtual nurse Anežka is also available for citizens on the website of the Ministry of Health, she will automatically answer questions about COVID–19 (for example about treatment, prevention or current measures) or it is possible to ask her a more specific question, which she will answer in the near future (Ministerstvo zdravotnictví, 2020/a)

Some health centres and other health care providers currently provide an Doctor Online service. This service responds to the current situation where people do not want to see a doctor, for example, due to the possibility of COVID–19 infection or other reasons such as long order times or overloading doctors. The online doctor is able to diagnose the underlying disease remotely through an interview/online camera call with the patient and also allows the issuance of an e–prescription for common diseases such as conjunctivitis, cough or urinary tract infections. This service is increasingly used, one of their main advantages is the availability 24/7 (EUC, 2020).

2.2. Ministry of Industry and Trade

The Ministry of Industry and Trade has introduced a chatbot, which advises entrepreneurs or the self–employed and informs about current government measures. In the period from 16 March to 31 March 2020, it was used

by almost 100 000 users. One of the most frequent inquiries was the form of compensation due to government measures.

Under the auspices of the Ministry of Industry and Trade, an application for care–giver´s allowance was launched, which was used by almost 80 000 applicants from 1 April to 30 April 2020. There is also, for example, the COVpoint portal, which connects those who offer and those who demand in the field of protective equipment, which, especially at the beginning of the COVID–19 epidemic, was in insufficient supply (Ministerstvo průmyslu a obchodu, 2020).

On the website of the Ministry of Labor and Social Affairs, a communication assistant is available for citizens, which works on the principle of chatbot and automatically directs users to a specified area and answers questions, some of which are predefined. In the case of a question that is not in the list of frequently asked questions, it is necessary to communicate directly with employees, e.g. by email or telephone (Ministerstvo průmyslu a obchodu, 2020/a).

2.3. Ministry of Education, Youth and Sports

The Ministry of Education, Youth and Sports has set up a special website on education and its forms during the COVID–19 epidemic. The website is divided into five sections: FAQ, online safety, virtual school, NoD Academy and psychological help.

The FAQ contains the most frequently asked questions of teachers and school principals about the situation and distance education. Online safety contains information on how to apply GDPR during distance learning. In addition to this issue, it focuses on the issue of cyberbullying and there is also a space devoted to the issue of controlling the use of the Internet by pupils / students, including videos for parents. The virtual school section contains sets for individual subjects containing exercises and tests from the subject matter. NoD Academy focuses on a new dimension of distance education: what methods to apply in teaching, how to apply them, current trends in teaching and lectures on various topics, such as drug prevention. The psychological help section contains a link to other websites – Psychological help for teachers and parents, where within 48 hours after completing the application for psychological help, the applicant is provided with this help

free of charge, either through a telephone conversation or by email (EDU, 2020).

2.4. Czech Social Security Administration

The Czech Social Security Administration has also launched a chatbot on its website called Virtual Advisor, which directs users to specific issues, if the issue is not specified, the user must again contact the official directly via email or phone (ČSSZ, 2020).

3. Evaluation of New Digital Services of Public Administration and Possibilities of Further Development

First of all, it is necessary to appreciate the effort and quite flexible response of these public administration institutions to the situation. The Ministry of Health responded the fastest and with the largest scope and availability of information and services, distributing several platforms that inform users about the current situation, as well as enable tracing, identification of potential co–infected people with COVID–19. The Doctor Online application is very positively evaluated by the public. It is also gaining in popularity as well as in the growth of users. It would be very useful to maintain this trend in the future, so it could reduce the burden on general practitioners (GP) if common problems were resolved through an online consultation and citizens only had to visit their GP if they had to be examined by them. It would also be easier for hospitals on days when GPs do not prescribe, and the influx of patients with normal difficulties is transferred to hospitals.

The issue of distance education is also well secured. Regarding the introduction of chatbots, the question is whether this was necessary, as it was usually possible to click on the issue through the websites of the public authorities. However, people who do not know the site will at least save time with searching in navigation or clicking on the issue. However, it should be noted that some public administration institutions (e.g. ministries not mentioned above or the state labour inspection office) did not react to the situation at all and placed an advertisement on the website, e.g. on e–

Rouška. Although, for example, an application informing, for example, about safety regulations in individual states would certainly be used.

The current epidemic situation has shown that it is possible to solve many things online and save time for both public authorities and citizens. In the future, these efforts by the public administration should certainly continue and be further developed. From the point of view of citizens who use these new digitized services, the response is very positive, as stated by the mentioned ministries as well as other public administration bodies on their websites.

4. Conclusion

Digitization of public administration has been a hot topic in the Czech Republic for a long time. Nevertheless, thanks to the epidemic caused by COVID – 19, the issue of digitization is again a topical issue that needs to be addressed. Public administration institutions are trying to react to the situation and each body will approach the issue differently.

The article focused on the description of individual newly digitized or newly introduced services of public administration institutions. The individual services were described in detail and subsequently evaluated. The most important beneficial and used services include applications from the Ministry of Health, such as Smart Quarantine or e–Rouška, as well as the Doctor Online, which replaces examinations/consultations with a GP in case of common problems such as conjunctivitis or cough. This application also allows doctors to issue an e – prescription for a patient, which makes it a very valuable public service in today's epidemic.

Some authorities reacted vaguely or not at all to the issue of contact with citizens during the COVID–19 epidemic. Therefore, in the future, it would be appropriate for the public administration to be even more open to the possibility of digitizing documents and its services to citizens without the need to set up data boxes or other platforms verifying the identity of the citizen. The use of digitized services is on the rise and it is clear that this trend will continue after the epidemic, as it saves time and money on both the public administration and citizens. Therefore, if the Czech Republic wants to be one of the developed countries in Europe, it should pay due attention to the digitization of public administration services, as other

developed countries do. More about digitization in the Czech Republic, for example in Slezák, J., Přikrylová A., Hakalová, J. and Bieliková, A. (2019).

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Using of Public Administration Digital Services by Citizens of The Czech Republic in SARS–CoV–2 Epidemic

Jiří Slezák[1], Ivana Čermáková[2]

Abstract. *The SARS – COV – 2 epidemic has had, and still has, a very negative impact on most entities, both in the Czech Republic and worldwide. The impacts are both health and economic. On the other hand, the positive aspect of the SARS – CoV – 2 epidemic is the increased interest in digital services provided by the public administration of the Czech Republic. However, the level of digitalization of public administration is outdated in comparison with most countries of the European Union, which is confirmed by the index of the digital economy and society (DESI), which monitors digital progress in individual countries. The aim of the paper is to analyze in more detail the behavior of citizens in terms of the use of digital services currently provided by public administration with a focus on financial management in connection with the SARS–CoV–2 epidemic.*

Keywords: Digitalization, SARS–CoV–2, Public Administration, DESI, Public Administration Services

JEL Classification: H24, K34

1. Introduction

SARS–COV–2 (COVID–19) SARS–CoV–2 (COVID–19) is a highly infectious type of disease, the main symptoms of which are high temperatures, respiratory problems (especially breathing problems), muscle pain, etc. COVID–epidemic 19 probably erupted at the end of 2019 in Wuhan, China, and spread rapidly virtually around the world (especially Asia, North and South America, and Europe). It is the rate of spread of the disease that is considered a serious problem, and as early as March 11, 2020, COVID–19 was designated by the World Health Organization (WHO) as a pandemic (ie, an epidemic with worldwide prevalence). The first cases appeared in the Czech Republic on March 1, 2020, and about 10 days later

[1] VSB – Technical University of Ostrava, Faculty of Economics, Department of Accounting and Taxes, Sokolská 33, Ostrava, 702 00, Czech Republic, jiri.slezak@vsb.cz
[2] VSB – Technical University of Ostrava, Faculty of Economics, Department of Applied and Informatics, Sokolská 33, Ostrava, 702 00, Czech Republic, ivana.cermakova@vsb.cz

the Czech Republic (CR) began to introduce various measures to prevent the spread of the disease among citizens, which further resulted in the declaration of a state of emergency (Ministerstvo zdravotnictví, 2020).

One of the many measures in place is the restriction of public administrations. For most, opening hours were limited and some offices, especially in smaller cities, were temporarily closed. Citizens were forced to start communicating mainly online, for example via e–mail, telephone or data box, but in some cases this was a problem due to the reluctance of citizens to communicate electronically, especially in the elderly. However, in some cases, when it is not possible to have a personal meeting, it is necessary to use, for example, a data box and an electronic signature, for example to submit forms. The problem also appeared on the part of the state administration, due to the long–term unpreparedness of its digitization, which lags far behind other states of the European Union (EU) (Money, 2020). According to the Digital Economy and Society Index (DESI), which monitors digital progress, in 2020 the Czech Republic ranks 17th out of all EU countries. However, it should be noted that in recent years, according to the DESI CR index, it has been improving, even though it is still below the EU average (Ec.europa, 2020). The beginnings of the digitization of the Czech Republic date back to 2005 and 2009. In 2005, the Czech Filing Verification Information National Terminal (CzechPoint) was introduced. In 2009, data boxes were introduced, which enable the sending of online data messages. The issue of digitization reopened especially in 2018, in which, for example, the Citizen's Portal, electronic records of sales, e–recipes, e–cadastre of real estate, etc. were introduced (Mylaw, 2020).

2. Citizen Portal

Citizen Portal enables online communication between citizens and public administration. It currently offers over 100 electronic services, however, the Citizen Portal only redirects to most services (for example, the Tax Portal). The most frequently used services include an extract from the driver's point evaluation, an application for an extract from the Criminal Register, Data from the State Administration of Land Surveying and Cadastre or an application for an extract from the use of data from the population register. Access to a larger number of electronic services is hindered, for example, by

the fact that there is no legal obligation for all public administration bodies to submit their data to the Citizen Portal (NKÚ, 2020).

From its introduction in 2018 until the end of February 2020, almost 250,000 citizens visited the Citizen Portal. The reason for such low popularity of electronic services was the lack of interest of citizens in these services, but also the insufficient promotion of the digitalization of public administration (Ministerstvo vnitra, 2020). Another reason for the low use of the Citizen Portal may be that most of the offered digital services are available only to citizens or entrepreneurs who log in to the Portal via a data box, which, however, has only a small part of the population (see below). Through the data box, it is possible, for example, to create a trade more online in the establishment of a trade online in KMPG, 2019. It is possible to log in to the Citizen Portal, for example, via so–called e–citizens. Approximately 1.9 million were issued, of which less than 250,000 had an activated certificate for electronic identification. Citizens can then use the electronic chip to create electronic signatures. (NKÚ, 2020). In 2021, login via a bank identity should also be launched. Banking identity is a long–prepared project, the launch of which already in 2021 could have, in the opinion of the authors of the COVID–19 epidemic. Through this banking identity, it will be possible to gain access to digital services not only of public administration. However, the entire banking market in the Czech Republic is not involved in this project (PWC, 2020).

3. Financial goverment

Due to the already mentioned limitations of state administration offices and forced online communication, the number of established data boxes has increased, as shown in Graph 1.

In addition to the reasons already outlined in the introduction to the paper (limited opening hours, recommendations to communicate online), the higher number of established data boxes was also influenced by the fact that the use of data boxes was (is) completely free during the COVID–19 epidemic or during the state of emergency. The possibility of using free data boxes has supported online communication and also prevents the gathering of people in offices (Ministerstvo vnitra, 2020/a).

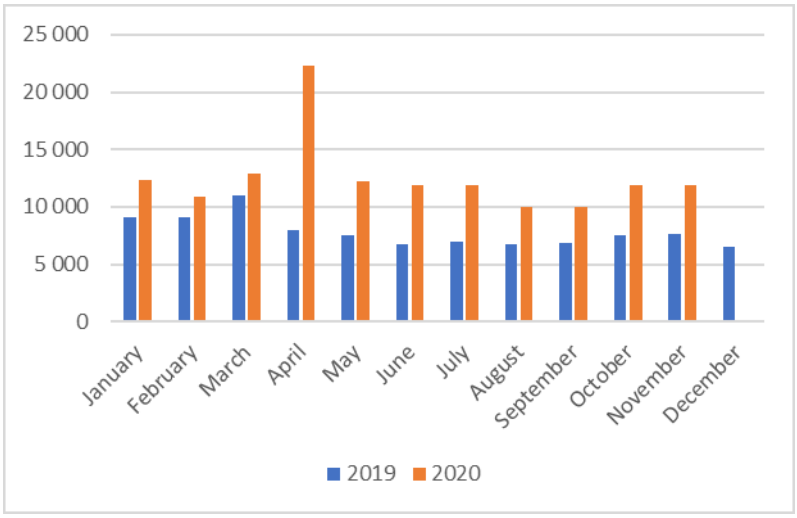

Figure 16 New data boxes between 2019 – 2020, Source: Datové schránky (2020)

Graph 1 shows that in all months for which data are available, the number of established data boxes increased in 2020 compared to the months of 2019 (data for December 2020 are not available, but a higher number can also be expected). In April 2020, the largest increase in the number of established data boxes was recorded compared to the same month in 2019, by 14 313, which represents an increase of almost 65 % (for individuals it is even a 162 % increase). On the contrary, the smallest increase is recorded in March 2020 compared to the same month of 2019, by 1 903, which represents an increase of almost 15 % (for natural persons it is by 33 %). As of 30 November 2020, a total of 1 172 819 data boxes were set up, which is 144 835 more than as of 30 November 2019 – 15% increase (Datové schránky, 2020).

In connection with the growing number of established data boxes and the COVID–19 epidemic, the number of data messages also increased in 2020 (Datové schránky, 2020).

3.1. Electronically filed tax refunds

Other areas of digitalization of financial administration with regard to the COVID–19 epidemic are also tax returns. Tax administration enables the filing of tax returns, both in physical form and in electronic form. However, physical filings of tax returns are more preferred than electronic filings, especially among individuals. Graph 2 shows a comparison of the number of

filed tax returns electronically between 2019 and 2020 for all direct taxes in the Czech Republic.

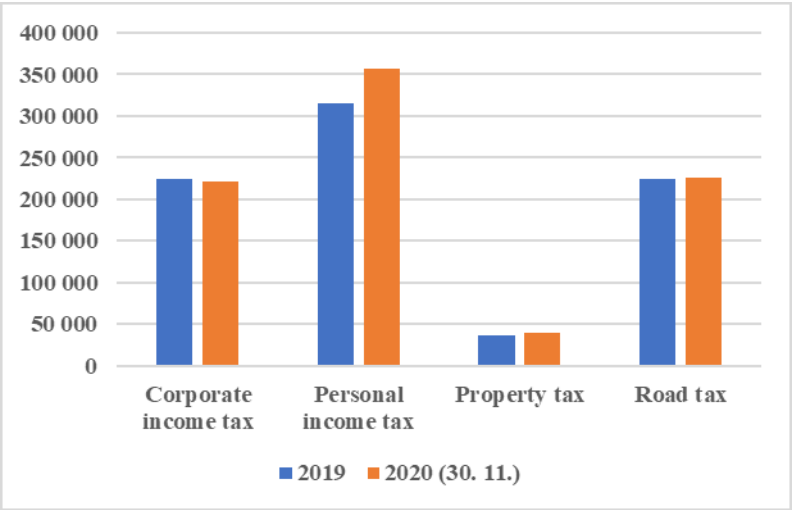

Figure 17 Electronically filed tax refunds between 2019 – 2020, Source: Finanční správa, 2020

The electronic filing of the real estate tax return, the standard deadline of which is 31 January, was used by a total of 39 725 entities in 2020, which is 2 540 more than in 2019. The electronic filing of the road tax return, the standard deadline of which is on 31 January, a total of 224 780 entities used it in 2020, which is 1 482 more than in 2019. The electronic filing of a personal income tax return, the standard deadline of which is used on 1 April, was used by a total of 356 680 entities in 2020 , which is 42 139 more than in 2019. The electronic filing of corporate income tax returns, the standard deadline of which is 1 April, was used in 2020 by a total of 220 777 entities, which is 4 012 less than in 2019.

In connection with the COVID–19 epidemic, the deadline for filing income tax returns was extended to 18 August 2020. A large number of business entities used the option to postpone filing tax returns. In the standard deadline for submission, ie: 1 April 2020, approx. tax returns. As of 3 April 2020, the number of filed income tax returns increased to approx. 1 400 000. confession. Compared to 2019, however, it is less by about 600 thousand (Fučík, 2020).

ePodpisFS is application created by public administration (financial administration) founded 1. 9. 2020. The app may create electronic signature for financial administration needs (Finanční správa, 2020/a).

3.2. Amendment to Act No. 280/2009 Coll., Tax Code

The COVID – 19 epidemic hastened the approval of the amendment to Act No. 280/2009 Coll., the Tax Code, which modernizes, simplifies and, above all, digitizes the existing tax system and also improves communication between tax authorities and tax subjects (Ministerstvo financí, 2020).

As part of the amendment, the *MOderní a JEdnoduché daně* (MOJE daně) project is being implemented, which is scheduled to be launched in January 2021. MOJE daně will enable online communication between tax entities and tax authorities and will replace or expand the existing tax information box portal. Through this portal it will be possible to file a tax return for all taxes in the Czech Republic, at the same time there will be the possibility of automatic pre–filling of the return based on the data stated in previous returns (name, address, subject of activity, etc.). Of course, there will also be a personal tax calendar with the most important tax dates that the tax subject is waiting for. All current internet websites and financial administration applications will be merged and connected with the so–called Citizen Portal (Ministerstvo financí, 2020/a).

Another effort to digitize tax issues in connection with the amendment to the Tax Code includes the already mentioned area of filing tax returns electronically. For taxpayers who decide to file a tax return electronically, the deadline for filing an income tax return will be extended by one month. This option should motivate taxpayers to use online services, which are currently not widely used by most individuals. Another novelty is the possibility of a remote form of communication in the case of tax audits by financial administration employees, which will certainly speed up its process (Ministerstvo financí, 2020)

4. Conclusion

The paper deals with the analysis of the use of public administration services in the field of digitization with a focus on financial management during the COVID–19 epidemic. Public administration in the Czech Republic has been

improving in the area of digitization, especially in recent years. The proof is the establishment of the Citizen Portal, electronic citizens, etc. However, the COVID–19 epidemic has shown that the Czech Republic is lagging behind in terms of digitization, for example due to insufficient promotion of digital services in the Czech Republic in recent years or citizens' reluctance to use these services. Digitization is important today, not least to tackle the COVID–19 epidemic, which will certainly shift the digitization process, as people have been forced to start using digital services. Digitization also leads to the strengthening of competitiveness and the shift of the Czech Republic among the more developed European economies, where we lag behind in this area, as shown, for example, by the DESI index. With a detailed focus on financial management and the above indicators, it is clear that during the COVID–19 epidemic, the possibility of online communication with authorities at a distance is gaining in importance, which is also visible in the above graphs. For these reasons, the authors recommend that the level of digitalization of public administration be further shifted and strengthened. More information about digitalization of public administration is in (Slezák, Přikrylová, Hakalová and Bieliková, 2019).

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